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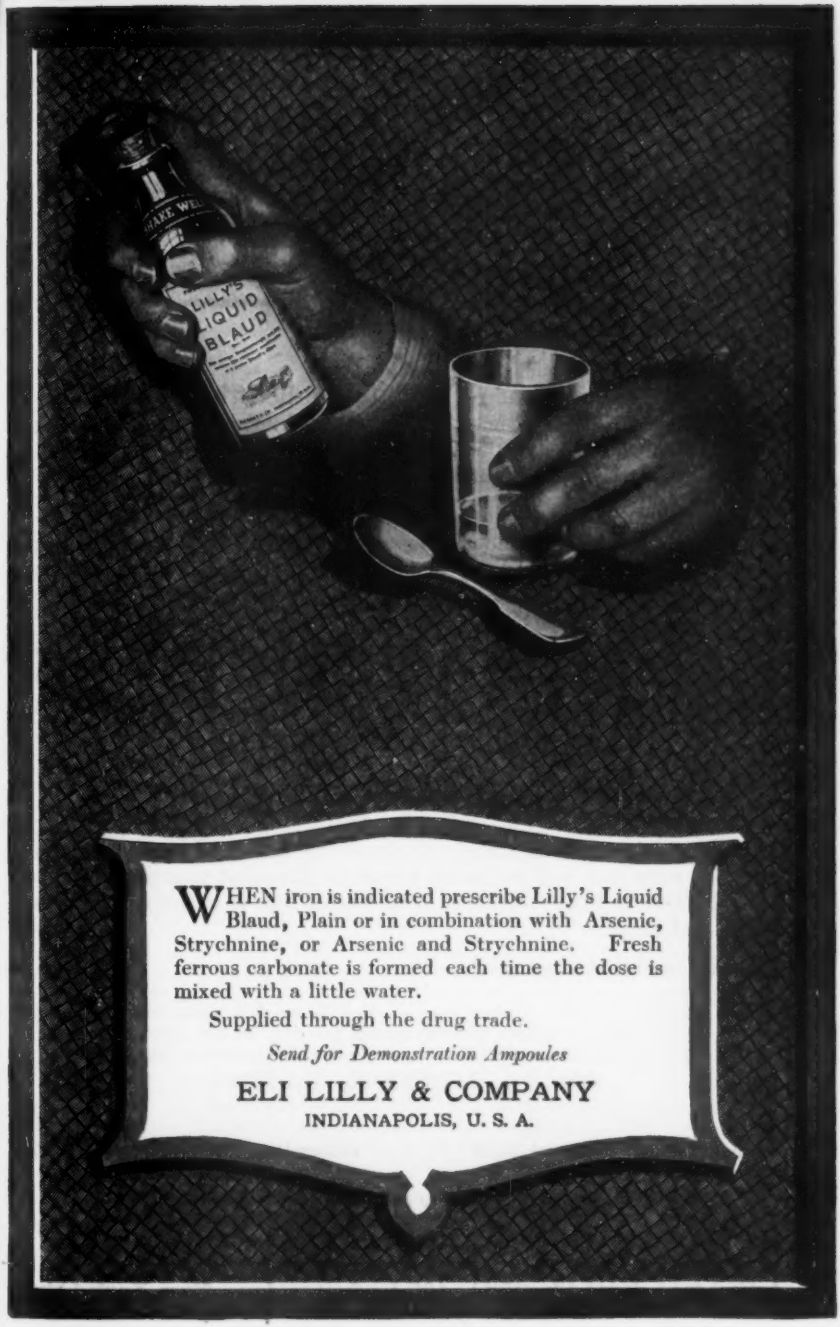

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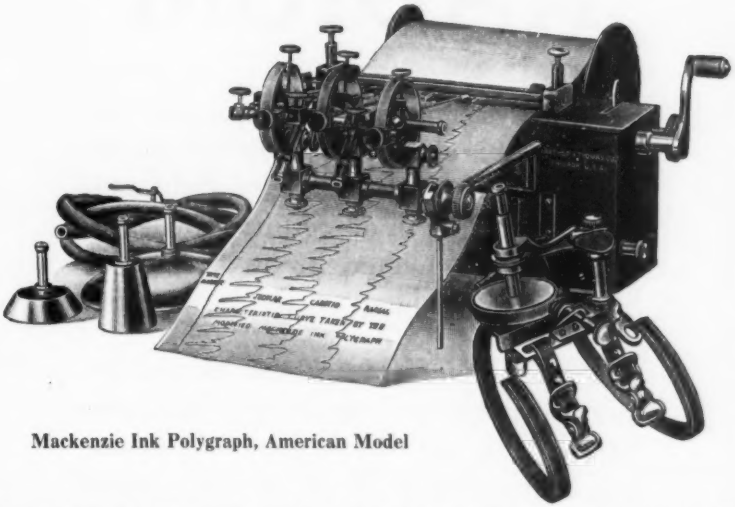

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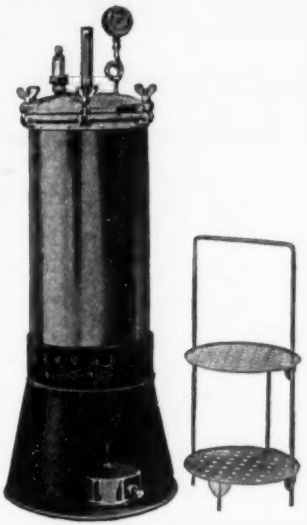

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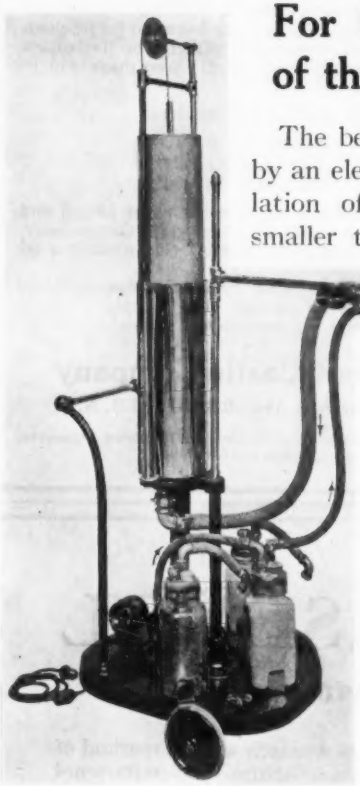

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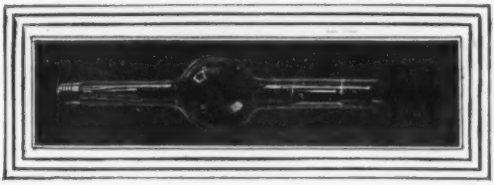

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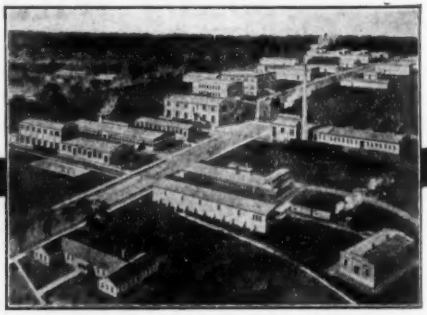

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ORIGINAL ARTICLES.

THE SYMPTOMATOLOGY AND DIAGNOSIS OF FOREIGN BODIES IN THE AIR AND FOOD PASSAGES. BASED UPON A STUDY OF 789 CASES.[1]

By Chevalier Jackson, M.D., F.A.C.S.,

PROFESSOR OF LARYNGOLOGY, JEFFERSON MEDICAL COLLEGE; PROFESSOR OF BRONCHOSCOPY AND ESOPHAGOSCOPY, GRADUATE SCHOOL OF MEDICINE, THE UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA, PA.

As an example of the importance of this subject the fact may be cited that the most frequent cause of the failure to diagnosticate foreign bodies in the lung, as shown by the case histories in the Bronchoscopic Clinic is that the practitioner is misled by the almost total absence of symptoms during the first few days or weeks. One estimable practitioner went so far as to assure a patient who had aspirated a large metallic foreign body (double pointed fence staple, Case No. Fbdy. 409) that such a thing was impossible, as it would have caused death in five minutes. There were no symptoms for four weeks in that case. The hitherto relative rarity of the cases in the experience of any one observer has prevented systematic study. Since the earlier publication a vast symptomatologic material has accumulated in the Bronchoscopic Clinic and additional data on physical diagnosis[2] have been gleaned, sufficient I think, to establish now a definite working basis. For the wonderfully able analysis of these data and their presentation in this paper I

[1] Read at the meeting of the American Laryngological, Rhinological and Otological Society, Boston, Mass., June 2, 1920.

[2] Jackson, Chevalier: See John W. Boyce and others in Peroral Endoscopy, 1914.

am indebted to my assistant, William H. Spencer. To him also credit is due for careful study of the signs and symptoms in all cases coming to the clinic during the last three years. His localizations by physical signs alone have been marvellously accurate in cases of foreign bodies in the trachea and bronchi and his observations are embodied herein. Consultations with Thomas McCrae have developed important findings which are elsewhere published,[3] and which for completeness are incorporated herein. Edwin E. Graham, who saw a number of cases in consultation, has published an interesting summary of the pediatric phases of the subject.[4]

SYMPTOMS OF FOREIGN BODY IN THE LARYNX.

It would seem that laryngeal symptoms should always be present at the time of aspiration of a foreign body through the larynx into the lower air passages, and it is true that the majority do give a history of varying degrees of irritation, spasm or obstruction of the larynx. There are, however, a very considerable number of cases in which no laryngeal symptoms are noted at any time, the foreign body probably passing through the larynx so quickly as to cause no irritation, as expressed by a girl of fifteen (Case No. Fbdy. 768), from whose bronchus a large open safety-pin was removed, "It went down like a drink of water." The history of the initial laryngeal spasm or paroxysm is, however, of most important diagnostic significance. The foreign body may be arrested at the entrance to the lower air passages and its presence may result in unconsciousness and even in death with the rapidity of a lightning stroke. Accounts in the daily press of the sudden choking to death of children while playing with beans, toys or what not are by no means infrequent. The author has a large collection of clippings reporting such accidents. Expulsion of the laryngeally lodged object is the happiest termination of this accident which many times happens, as almost everyone can testify from personal experience. The object may be of such size and shape as not completely or seriously to obstruct the glottis, and a relative degree of toleration may be established. *Cough*, at first severe, subsides after a short time, but may persist and become croupy. I have often noted severe distressing cough on insertion of the bronchoscope without an anesthetic, general or local, yet the cough would subside in a few minutes afterward, with the tube continuously in place. A triangular portion of the sternum of a chicken was removed from the larynx of a boy of eight years (Case No. Fbdy. 706), where it had lodged for twenty-five days, causing only a slight degree of stridor

[3] McCrae, Thomas: The Physical Signs of Foreign Bodies in the Bronchi, Am. Jour. Med. Sc., March, 1920, No. 3, clix, 313.

[4] Graham, Edwin E.: Foreign Bodies in the Air and Food Passages, Am. Jour. Dis. of Children, February, 1920, xix, 119–133.

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and some slight hoarseness. One of the basal angles rested in the posterior and the other in the anterior commissure of the glottis, the apex being down. The noteworthy lodgment in the larynx for four and a half months of a piece of a thin glass from a broken Christmas tree ornament in a child of fifteen months produced no serious degree of dyspnea or other general disturbance other than a marked impairment of phonation and a laryngeal wheeze. There occurred also at times severe paroxysms of coughing simulating whooping-cough. An interesting point in this history was the statement of the mother that on seeing the child gagging and choking she inserted the finger into the mouth in an endeavor to remove the foreign body. This method used so frequently by parents, the patient himself, or, in some case, the doctor, is responsible many times for the entrance of the foreign bodies into the larynx which would otherwise remain in the esophagus or be swallowed, and the trauma thus caused may produce symptoms, especially croupy cough, that mislead by persistence after the foreign body itself has passed on downward into the air or food passages. Guthrie[5] reports the remarkable sojourn of a piece of rabbit bone, measuring 14 by 21 mm., for eighteen months in the larynx of a girl of eleven years without producing sufficient reaction to cut off the airway completely. This is, however, not the usual course of events, for prompt reactionary swelling of the larynx usually renders breathing so labored that inspection of the larynx is called for and the intruder is discovered and removed.

Dislodgment and the passage downward of the foreign body may completely relieve the laryngeal symptoms if the stay of the intruder in the larynx has been brief. Often some laryngeal irritation persists for a time as an evidence of the duration of the laryngeal lodgment. As an indication of the toxicity of the peanut, marked subglottic swelling was observed in a girl of five years, three hours after the aspiration of half a kernel of a jumbo peanut. The parents stated that the initial paroxysm of cough, dyspnea, cyanosis and vomiting lasted for a half hour, then suddenly subsided (Case No. Fbdy. 769).

Recurrence of the laryngeal paroxysms suggests the lodgment in the larynx of a movable foreign body or it may result from the coughing of a movable foreign body in the trachea up against the under surface of the chords. One must always keep in mind sudden asphyxia from a possible lodgment in the glottic chink of a large tracheal foreign body which has been forced upward by bechic powers or by attempts made to aid in expulsion by holding the patient head down and feet up.

The *subjective sensation* of an intruder is usually present in cases of a laryngeally lodged foreign body during the first days of lodg-

[5] Jour. Laryngol., Rhinol. and Otol., February, 1919, xxxiv, 38.

ment. There is often also rather sharp *pain* near "Adam's apple" or referred to one or both ears. If the arytenoid region is affected there may be *odynophagia*, or the patient may complain of pain of a piercing character on swallowing, due to movement of the object during the closure of the larynx. This has often led to the mistake of diagnosticating esophageal lodgment. Irritative croupy cough is usually present and is often unproductive. *Phonation* is apt to be seriously impaired, although aphonia is not common. The sputum may be blood-streaked, and in those localities where leeches abound the not infrequent attachment of a leech to the larynx is productive of copious hemoptysis. *Dyspnea* varies in degree with the size of the intruder and with the degree of swelling it produces by its presence in the larynx. There is usually a distinct laryngeal stridor, which with the dyspnea immediately suggests diphtheria to the practitioner and for which, in case of doubt, he wisely administers diphtheria antitoxin. Fever and general disturbance are usually absent unless a perichondritis of the laryngeal cartilages is present. Tooth brush bristles, fish bones and other small and pointed objects may become forced beneath the mucosa and cause this distressing condition with its sometimes disastrous destruction of the framework of the larynx and its usual sequel of laryngeal stenosis.

The diagnosis of laryngeal foreign bodies in infants and young children depends much on the history. The sudden onset of signs of laryngeal obstruction during apparent perfect health is rarely found in disease; though patients sometimes say the onset was sudden in laryngeal disease of considerable duration and in some cases of foreign body the obstruction does not set in at once. If the child were known to have had some object in its mouth previous to the onset of the symptoms the diagnosis is rendered almost certain. Adults, of course, can usually give definite history of the accident, although the aspiration may occur during narcosis or unconsciousness. In children the object may have been inhaled during an unwatched moment. Every case of suspected foreign body should be radiographically studied and plates made in the lateral as well as anteroposterior positions. This study should be made even though the object may be thought not to be radiopaque, for it has been our observation that the patient and parents may be mistaken in the identity of the foreign body—what was thought to be a fragment of bone may prove to be a piece of solder, tin or enamelware, etc. It is remarkable with what clearness the details of the larynx and trachea may be shown by a skilful roentgenologist and in many cases even non-metallic foreign bodies can be definitely shown.

Diphtheria is the disease most liable to be confounded with laryngeal foreign body lodgment. The error has occurred both ways—diphtheria being mistaken for foreign body, and *vice versa*.

The administration of antitoxin is wisely done in cases of doubt while waiting to complete the diagnosis.

Hoarseness in angioneurotic edema involving the larynx may simulate in rapidity the symptoms of laryngeal foreign body, but there will be the history of previous symptoms of the condition in other parts of the body, and perhaps also in the larynx. Edema of the larynx from other general conditions will be of slower onset, and study will reveal the basic factors. Influenzal laryngeal edema occurs, as a rule, during epidemics. First cases in epidemics may not be recognized.

Definite diagnosis can be made with mirror laryngoscopy in adults and with the direct laryngoscope in children. All preparations for removal of the foreign body by bronchoscopy and for tracheotomy should be made before direct laryngoscopy is attempted in children with suspected laryngeal foreign body, for shifting of the foreign body may cut off the airway, it may be aspirated into the lower air passages where we would wish to follow it with the bronchoscope, or other accidents occur. The facile bronchoscopist will insert the bronchoscope quicker than tracheotomy can be done. It should be emphasized that general anesthesia is to be avoided during removal because of the danger of asphyxia. Sterile swabs for culture material should be at hand, though usually diphtheritic cases, coming as suspected foreign body, are readily diagnosticated visually by direct laryngoscopy.

SYMPTOMS OF FOREIGN BODY IN THE TRACHEA.

The glottic chink is much smaller than the tracheal lumen, therefore objects which pass through the larynx are rarely large enough to become impacted in the trachea. A bolus of food may because of its consistency fill the trachea and result in prompt asphyxia, but most tracheal foreign bodies, unless sharp-pointed are movable, and produce a diffuse traumatic tracheitis in their migrations, and may terminate suddenly by asphyxia through impaction in the glottic chink. Organic substances, such as beans, maize and large nut kernels, are frequent tracheal intruders, although any object small enough to pass the glottic chink yet too large to enter either main bronchus may be found.

We have, as a rule, the history of an initial laryngeal spasm which subsides but leaves the patient with a wheezing respiration and a cough. The wheezing is usually louder than that heard in bronchial foreign bodies, and often has a lower pitch than the true "asthmatoid wheeze." Cough is a most distressing symptom, coming in paroxysms which may be so severe as to produce vomiting. Cyanosis and dyspnea often accompany the cough, and one may perhaps hear a flapping sound as the foreign body moves in the trachea.

The patient can feel the movements of the foreign body and palpation of the trachea will reveal the vibrations of these movements, which may also be heard by placing the stethoscope over the trachea.

If the foreign body be not removed, increasing dyspnea occurs, produced by the swelling of the subglottic tissues and tracheobronchial mucosa from the trauma of the object, aided in cases of organic substances by increase in bulk of the object itself, due to the absorption of fluid. Sudden asphyxia is always a danger, for a powerful bechic action may jam the foreign body between the chords. The tracheal area of cross-section being larger than that of the glottis a foreign body may permit air to pass it freely, whereas if jammed in the glottis the airway may be dangerously or even completely occluded. For this reason early removal is often imperative. If the foreign body be pointed, pain may be a symptom, and it may be localized more or less accurately by the patient over the site of impaction. This is rare, but a few such cases have come to the Bronchoscopic Clinic. A foreign body free to move in the trachea will usually cause more cough than a foreign body fixed in one position in the trachea or a bronchus.

The symptoms of tracheal foreign body were well shown in a boy of two and a half years (Case No. Fbdy. 784) who aspirated a kernel of dried maize. There immediately occurred an alarming paroxysm of choking and cyanosis. Wheezing and labored respirations followed and peculiar spasmodic coughing attacks recurred at frequent intervals. The expiratory bechic blast seemed suddenly cut off with a valve-like click, after which inspiratory dyspnea and cyanosis would be present for a short time. The above condition could be produced by lowering the head, and was relieved by placing the child in the upright position. It was plainly due to the impact of the kernel of corn against the under surface of the chords in its migrations in the trachea during coughing. If the child were crying at the time a sudden cutting off of the phonation occurred when the foreign body reached the subglottic region—in a manner so characteristic as to be unmistakable when once heard. A palpatory vibration was present during these coughing attacks and the stethoscope could plainly hear the rumble of the shiftings of the corn. During the intervals between attacks it was easily made out by physical signs that the corn was lodged in the orifice of the right main bronchus, and at these times no dyspnea was present. Spencer after his physical examination assured me positively that the foreign body was loose in the trachea, and at bronchoscopy I so found it. The asthmatoid wheezing and paroxysmal coughing ceased immediately after the removal of the foreign body. Sudden shutting off of both the expiratory blast and phonation during paroxysmal cough is almost pathognomonic of a movable tracheal foreign body.

SYMPTOMS OF FOREIGN BODY IN THE BRONCHI.

Unknown Presence of Bronchial Foreign Bodies. While the history of an initial laryngeal spasm is of great importance in the diagnosis of a foreign body in the lower air passages, the lack of such a history by no means excludes the possibility of foreign body being present. The inhalation may have occurred in childhood; the accident may have been forgotten or overlooked under stress of emotion; it may have occurred during unconsciousness or under narcosis; for instance, in tooth extraction; the size and shape of the foreign body having been such as to allow its rapid passage through

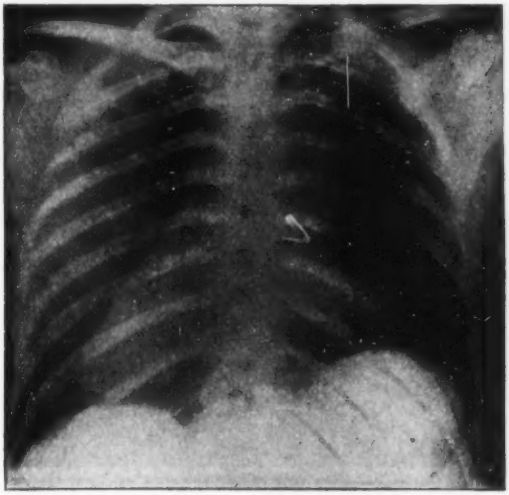

FIG. 1.—Roentgenogram showing pin in right lung of a woman, aged thirty-eight years, admitted dying of pulmonary hemorrhage and showing all other symptoms of pulmonary tuberculosis, but lacking bacilli in the sputum. No bronchoscopy was done. Postmortem showed absence of any tuberculous lesion.

the larynx without causing irritation. Our case histories show many instances in which the presence of a foreign body in the lung was not known until a radiograph was made. A particularly sad case was that of a woman, aged thirty-eight years, who was brought to Jefferson Hospital in a moribund condition due to repeated hemorrhages and sepsis, the result of the presence of an open safety-pin in the right stem bronchus (Fig. 1). She had been treated for tuberculosis for many years, and five years before admission had had a radiograph of the chest which showed the open safety-pin in the bronchus. At the time she was having a remission of symptoms, and her physician, being evidently unaware of the safety and

success of bronchoscopy in such cases, advised against the removal of the foreign body on the principle of "leaving well enough alone." Six months before admission hemorrhages commenced and continued until she was brought to the hospital in an exsanguinated condition, dying the next day. No bronchoscopy was done because of the extreme gravity of the patient's general condition and because the fatal bleeding was not directly due to the pin but to the erosion of a

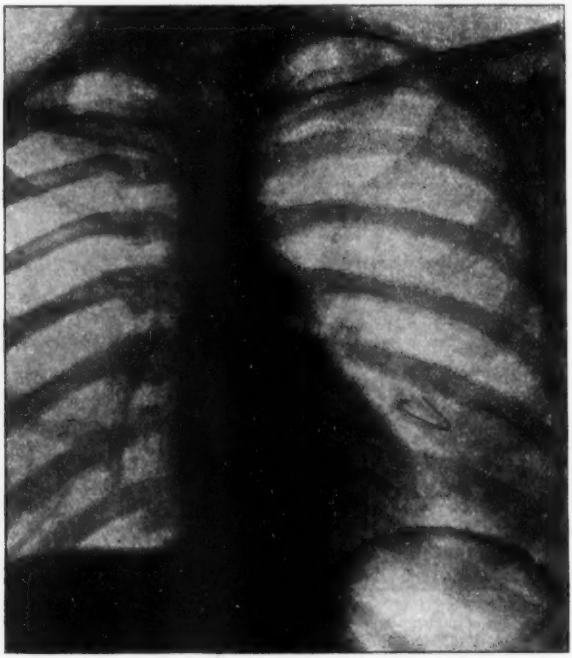

FIG. 2.—Case No. Fbdy. 748. Open bar pin in left lung of a girl, aged twenty-one years. Time of aspiration thought to have been when patient was three years old. Symptoms were those of chronic cough and purulent expectoration. Slight asthmatoid wheeze present at times. Complete recovery after removal by peroral bronchoscopy, under local anesthesia, in nine minutes fourteen seconds. Plate by Willis F. Manges.

vessel by the suppuration originally started by the pin. Autopsy by E. D. Funk revealed extensive destruction of lung tissue but no tuberculous lesions.

An atomizer tip was unknowingly aspirated into the lung of an adult intelligent business man (Case No. Fbdy. 611[6]) while spraying

[6] Jackson, Chevalier: See illustration in the Mütter Lecture, Surg., Gynec. and Obst., March, 1919, pp. 201–261.

his own throat. He also had received sanitarium care for supposed pulmonary tuberculosis until a radiograph of the chest revealed the metallic object. Complete recovery of health followed the bronchoscopic removal of the foreign body. It has for many years been my earnest teaching that every chronic chest condition should have the benefit of a radiographic study, even though it be thought tuberculous, but particularly if tubercle bacilli had not been found in the sputum. No more striking confirmation of the value of this procedure can be evinced than the statement of a physician in a Southern State that after the installation of a roentgen-ray apparatus in a tuberculosis sanitarium with which he was connected a routine

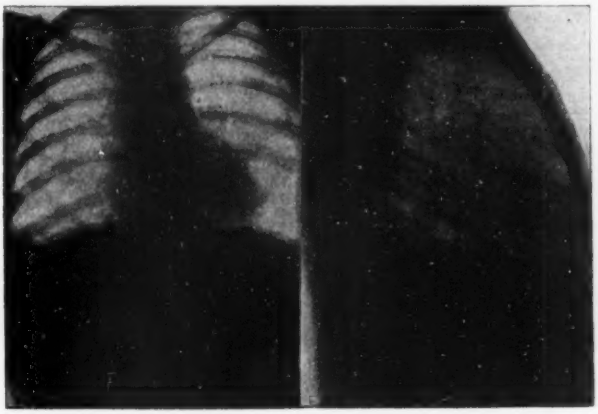

FIG. 3.—Case No. Fbdy 659. Roentgenogram showing metallic umbrella-tip very low in the right lung of a boy aged eight years. Entered the lung probably at about two years of age, reaching its low position in six years by pathologic processes. Symptoms: Complete bronchiectatic syndrome. Foreign body unsuspected. Diagnosis by roentgen ray. Peroral bronchoscopic removal without anesthesia. Recovery. Plates by David R. Bowen.

radiographic study was made of about 200 patients, and in one case a bronchial foreign body was found to be the cause of the chest symptoms, there being no tuberculous process present. On the other hand, leaning too heavily on the roentgen-ray laboratory leads to an equally deplorable state of affairs. The author deplores the fact that he for years neglected in many cases to have proper study by a physical diagnostician in cases of foreign body that showed plainly in the ray. Such study should never be neglected because of the great value of physical diagnosis which is our only dependence in non-opaque foreign bodies. Over and over again Spencer has been able precisely to locate by physical signs alone non-opaque foreign bodies.

Latency. After entering a bronchus a metallic foreign body or one of dense non-irritating character which does not completely occlude the lumen may cause no symptoms for a period of weeks or months. It is this period of delusive calm which allays the fears of the patient or parents and gives a false confirmation to the practitioner's assurance that there can be nothing in the lung. Pathologic changes, however, progressively develop and show themselves in an ever-increasing train of symptoms which will ultimately invalidize the patient (Fig. 3).

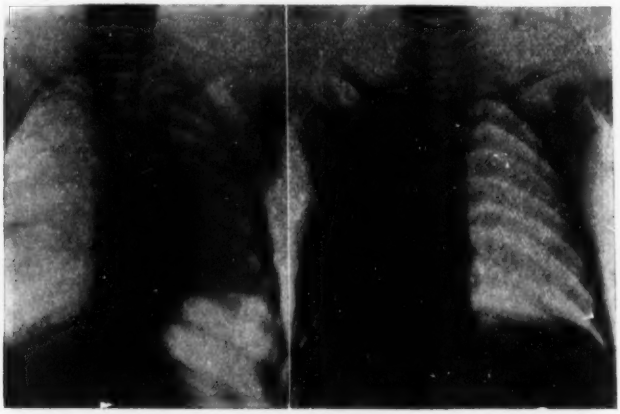

FIG. 4.—Case No. Fbdy, 645. Roentgenogram showing small electric lamp in left lung of a boy aged six years; left main bronchus tightly "corked." Lamp *in situ* six days; left lung atelectatic; right lung emphysematous. Mediastinum displaced to atelectatic side. These changes were demonstrable by physical signs. Lamp was removed without anesthesia in one minute nine seconds. Roentgenogram at the left was taken ten minutes after removal, and shows air beginning to enter the collapsed lung. Recovery complete in twenty-four hours. Symptoms: Fever, cough, dyspnea, distress. At first thought to be pneumonia. Physical signs: Greatly limited expansion on the left side. Impaired resonance above and flatness below the fourth rib, front and back. Breath sounds intensely tubular, with few fine crackling rales above fourth rib. Below breath sounds very distant and vocal resonance much diminished. Right side of chest hyperresonant, with harsh breath sounds and numerous loud harsh rales. Plates by Arthur C. Sender.

Rapid Onset of Symptoms. If a bronchus is completely plugged reaction is usually prompt and violent even though the foreign body be in itself of a relatively non-irritating nature (Case No. Fbdy. 645, Fig. 4). Organic foreign bodies, such as nut-kernels, especially that of the peanut, are evidenced by marked general toxemia and local reaction in children under two years of age. Within twenty-four hours the child may be gravely ill and may even die. Children over two years of age do not react so severely to the organic objects, whether it is because of their higher degree of resistance or larger air passages and greater bechic powers has not been determined. It is

a well-established fact, however, that the symptoms are in inverse proportion to the age, so that a peanut-kernel in the bronchus of a child aged ten years seems but little more irritating than the denser foreign bodies. To this disease we have given the name "arachidic bronchitis."[7]

Tactile Sense of Bronchial Foreign Body. After the foreign body has invaded a bronchus the patient loses his power to localize it by tactile sensation. It is not unusual for bronchoscopy to be requested because of the supposed aspiration of an object which the patient feels to be present. A number of these requests were from neurotic

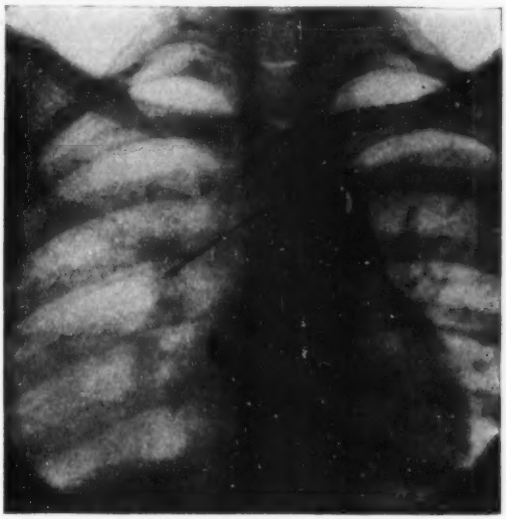

FIG. 5.—Case No. Fbdy, 768. Open safety-pin in right main bronchus, spring end at carina, keeper at orifice of middle lobe of bronchus, point in upper lobe of bronchus. Pain localized by the patient in the lower chest and epigastrium, worse on deep breathing and cough. It was especially noted by McCrae on inspection that expansion was decreased on the invaded side, though the foreign body was not obstructive. Plates by Willis F. Manges.

individuals, some of whom had read popularized versions of bronchoscopy in the daily press. The lack of other symptoms and a negative radiographic study should prevent unnecessary bronchoscopy —which in hysterical individuals would but confirm them in their belief in the presence of the foreign body.

Pain in Cases of Bronchially-lodged Foreign Body. Although pain in the chest is a rare accompaniment of bronchial foreign bodies in our experience, there are a few exceptional cases, such as those

[7] Jackson, Chevalier, and Spencer, William H.: Arachidic Bronchitis, Jour. Am. Med. Assn., August 30, 1919, lxxiii, 672–677.

cited below, in which it has been localized to the site of the intruder. The pain is rarely severe, but is of an annoying, piercing nature, made more intense by deep breathing or coughing. In all of the cases observed a pointed foreign body was present. An interesting history was obtained from a girl of fifteen years who had aspirated a large safety-pin which she was positive as having been closed by her before being placed in the mouth and which she states entered the air-passages with no irritation whatever (Case No. Fbdy. 768). Three days after the accident there occurred, during

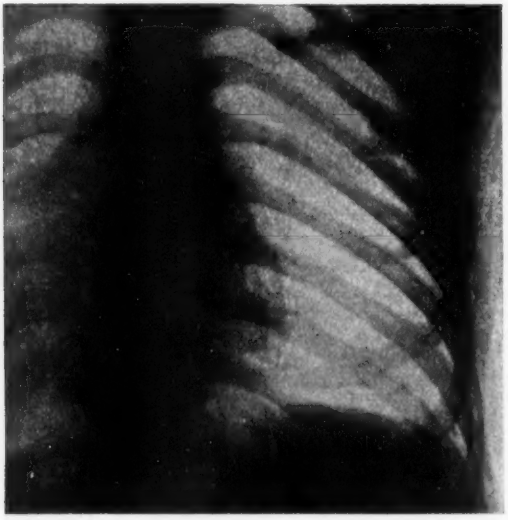

FIG. 6.—Case No. Fbdies. 774–775. Two thumb tacks in right lung. First one encountered in right main bronchus at orifice of upper lobe bronchus. Second tack point downward, the entire bronchial lumen being shut off by the head of the tack. Patient complained of pain in the upper right chest at times in the region of the tacks. Inspection showed limited expansion on invaded side. Markedly diminished breath sounds distal to the foreign body. Peroral bronchoscopic removal of the tacks without anesthesia in five minutes and twenty-eight seconds resulted in immediate disappearance of the pain. Plates by Willis F. Manges.

a coughing attack, a sudden, sharp pain over the location of the foreign body, as shown by the radiograph (Fig. 5) and later during coughing she felt a piercing sensation at this location. The safety-pin was much too large to pass through her larynx open, and point downward, so we must assume that it was closed at the time of aspiration and opened later during a coughing attack. The pin-point was found defective on examination after removal, so that the endobronchial opening was entirely possible.

A boy of twelve years (Case No. Fbdies. 774–775 Fig. 6) was

able, by the pain sense, to localize on his chest wall the site of lodgment of two thumb tacks lying, head together, in the right main bronchus. A woman of forty-eight years (Fbdy. No. 664, Fig. 7), was sent in to have a double-pointed tack removed from the lung. Her main symptom was the sharp, pricking pain at its site of impaction. It seems indicated by my observations that the pain sense is irregularly distributed to certain areas and to a less extent or not at all to others. In all the foregoing cases the location was verified by subsequent bronchoscopic removal from the location indicated by the patient. These cases show that there are at least some

FIG. 7.—Case No. Fbdy. 664. Double pointed staple in left bronchus at orifice of upper lobe bronchus; points upward. The patient localized a dull, aching pain in the fifth left interspace about two inches from the midline. This pain was aggravated by coughing, and after the first few days was referred to the back. Diminished expansion through foreign body was not obstructive. Peroral bronchoscopic removal was accomplished in two minutes thirty-five seconds by version and resulted in immediate disappearance of the pain. Plates by David R. Bowen.

locations in which the pain sense is present and correctly localizable by the patient. These locations are:

1. Left bronchus at orifice of upper-lobe bronchus.
2. Right main bronchus and stem-bronchus from carina to middle-lobe bronchus.
3. Right main bronchus at orifice of upper-lobe bronchus.

Doubtless there are many other localities with equally localizable sensation, but these are cited as definitely proved. In many other cases pain complained of after the patient had seen the ray plate was not recorded because it was obviously psychic.

Diffuse aching sensations throughout the chest are very occasionally observed in bronchial foreign body cases. If the pathology induced by the foreign body reaches the pleura, pain is, of course, a symptom, but one cannot include this as produced by the foreign body itself. George L. Richards (*loc. cit.*) reports a case in which pain in the chest along with an unexplained leukocytosis and the occasional discharge of pus suggested to him the diagnosis of foreign body in the chest, which was later confirmed by a radiograph and the bronchoscopic removal of a tack.

Taste and Odor. One patient, from whose bronchus a much corroded iron carpet staple was removed, complained of an inky taste in the mouth after coughing. The taste and odor of the pus in long retained foreign body cases, in some instances, causes nausea as well as anorexia. Decomposing foreign bodies will be subjectively known to the patient by the taste and odor they induce, though, as in other cases, foul sputum is less noticeable to the patient than to others. After a prolonged bronchoscopy in a foreign body case of long standing the author has often himself had the subjective sense of taste corresponding to the peculiar foul, penetrating, offensive odor resulting from the decomposition of the dead organic material by the saprophytes. This odor and taste differ in character in different cases; but is foul in practically all cases of prolonged sojourn of a foreign body in the lungs. Recent cases of such substances as bones, especially when periosteum or other tissue is attached, give in some cases an objective and subjective odor and a subjective taste to the spectator. In both of these and the long sojourn cases the foulest odors are only mildly offensive to the patient. The author has always found the odor becomes less and less offensive in a prolonged bronchoscopy, unless a new pocket with a different odor is opened up and drained by the bronchoscope. An odorous sputum is strongly suggestive of a foreign body when the question arises as to whether a chronic chest condition is due to tuberculosis or other causes.

Dyspnea. The compensatory power of one lung during bronchial obstruction of its fellow is truly remarkable. Even with no air entering the affected lung the subjective sense of dyspnea is rarely felt. It has been many times observed in the clinic that a recently inhaled foreign body has shifted from one side to the other, each time causing complete blocking of the invaded bronchus, yet the patient was unaware of the change and at no time was short of breath. It is to be emphasized that this holds true only in the case of recently aspirated foreign bodies, for if a bronchus has been blocked for a sufficient time to allow extensive inflammatory changes in the obstructed lung its aërating function is arrested, so that shifting of the foreign body and obstruction of the opposite lung may prove quickly fatal. This is well illustrated by the happenings at bronchoscopy in a child of twenty-one months (Case No. Fbdy. 725 Fig. 8),

who had had a peanut-kernel in the right main bronchus for two weeks. The right lung was the seat of extensive inflammatory reaction and the little one was seriously ill from the toxemia and the diffuse laryngo-tracheobronchitis (arachidic bronchitis) usually

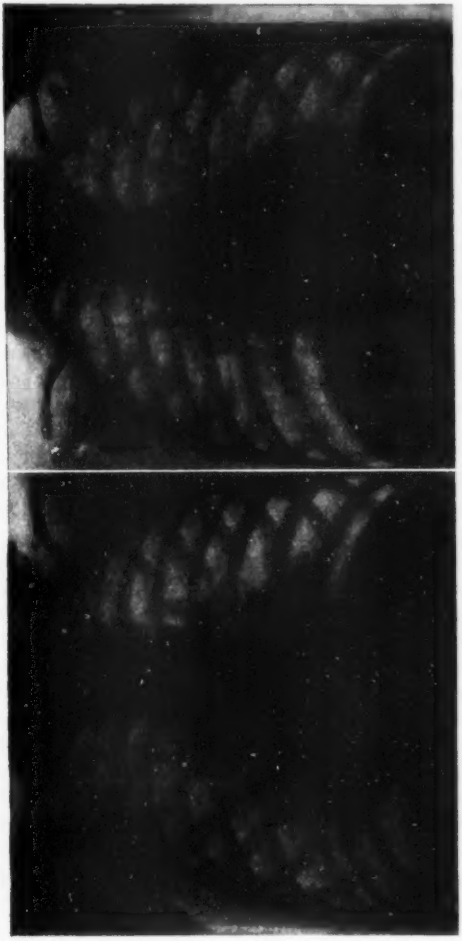

FIG. 8a.—Case No. Fbdy. 725. Peanut kernel in right main bronchus. Wheezing respiration present. Note increased transparency of the right lung. Abscess formation in lower right lobe. Note depression of diaphragm.

FIG. 8b.—Two days later after removal of peanut. Right diaphragm in practically normal position; right and left lungs show equal density. Abscess density has largely disappeared.

associated with peanut-kernels. After the insertion of the bronchoscope a sponge introduced to remove the copious secretion in the trachea caused a hard cough, which was followed by intense cyanosis. After a few gasps for breath, respiration ceased even with the bronchoscope *in situ*, affording a free airway. Insufflation of

oxygen through the side tube of the bronchoscope and artificial respiration were rewarded after three minutes by a return of voluntary respiratory efforts, although the cyanosis did not completely disappear. Careful search of the right bronchus revealed great inflammatory reaction. Much accumulated pus and a few fragments of peanut-kernel were removed. While oxygen was being piped down into the right bronchus the child again became deeply cyanosed and ceased breathing. The bronchoscope was now inserted into the left main bronchus, from which a large peanut kernel was removed, resulting in an immediate disappearance of the cyanosis, restoration of respiration and return to normal. It is apparent that the kernel was dislodged at the time the first sponge was introduced and was reaspirated into the left bronchus, blocking the only aërating organ, the right lung being incapacitated by inflammatory reaction. Had the dislodgment occurred at any other than the fortunate time in which the bronchoscope was in position death would have occurred promptly and inevitably. It is also probable that had the bronchoscopy been performed under general anesthesia respiration could not have been restored. In passing it may be mentioned that in these cases neither anesthetic nor sedative should be administered for the bronchoscopy, because the voluntary respiratory and bechic efforts of the patient are required to free the air-passages from secretion and maintain the respiratory function, even though it be for many seconds interrupted. Prolonged mechanical obstruction to respiration introduces an enormous element of danger to general anesthesia.

Cyanosis is a symptom of suddenly produced dyspnea and is not often seen in case of obstruction produced by a bronchial (not tracheal or laryngeal) foreign body unless under the conditions recited in the above-mentioned case. Slight cyanosis of the fingernails and lips may be present in arachidic cases because of the laryngeal swelling and accumulation of secretions in the bronchi, which interfere with aëration of the blood. Prolonged dyspnea results in death from exhaustion and is evidenced by gradually increased ashy pallor, anxious facies, sweating, restlessness and gradual heart failure. The cardinal signs of obstructive dyspnea—inspiratory retraction of the lower ribs, epigastrium, supraclavicular and suprasternal fossæ—should be carefully watched, their degree of severity and the condition of the heart should decide the urgency of tracheotomy. Children have been allowed to die because the attendant watching the case considered cyanosis the principal sign of severe dyspnea.

Cough, so immediate a symptom in laryngeal or tracheal foreign bodies, is often not developed in bronchial cases for a number of weeks after the inhalation of a non-irritating foreign body, such as one of metal. After this symptomless interval of longer or shorter duration an unproductive, irritative, hacking is usually noticed.

This in some cases becomes more and more severe until the cough racks the patient, interfering with sleep and even producing vomiting. An ever-increasing amount of sputum is expectorated—at first whitish and mucoid, becoming green, yellow and purulent; and as retention increases, in a bronchiectatic or abscess cavity, a foul odor is developed which is most distressing to the patient and friends. A few cases show surprisingly little of both cough and expectoration. In marked contrast to metallic foreign bodies the aspiration of organic substances is followed immediately by paroxysmal, sometimes croupy cough, and the secretion of pinkish-gray purulent sputum. Coughing is attended by dyspnea and cyanosis because of lodgment in the swollen larynx of the thick, mucilaginous pus which is with difficulty expelled by the child. In a recent case (Case No. Fbdy. 787) with arachidic bronchitis, violent, exhausting paroxysms of coughing continued as long as an hour.

Hemoptysis, varying from blood-streaked sputum to copious hemorrhage, is not an uncommon symptom with pointed bronchial foreign bodies. The previously mentioned case of safety-pin in the lung for an unknown number of years resulted fatally from prolonged and repeated hemoptysis. It is well known that the initial symptom of a tuberculous lung involvement may be a pulmonary hemorrhage. An example of the close simulation of the entire tuberculous syndrome by bronchial foreign bodies is seen in the case of a woman, aged forty-one years (Case No. Fbdy. 726, Fig. 9), from whose right bronchus a large bent shawl-pin was removed by peroral bronchoscopy after a sojourn of twenty-eight years. At the age of thirteen, while dressing a doll, she told her parents she had swallowed a bent shawl-pin, and the incident was noted in the father's diary at the time. Because of failure to find the pin in the stools and the lack of symptoms of any nature it was assumed that she had been mistaken. A moderate cough developed but was not considered serious enough to demand medical treatment. The patient married at eighteen and after puerperium was one day found unconscious from severe pulmonary hemorrhage. Recurring hemorrhages kept the patient in bed for five months, after which a gradual convalescence returned the patient to a degree of health, allowing her to assume some of the household duties. The cough, however, became increasingly more severe, and at intervals of a few months, attacks characterized by fever, sweats and malaise would confine the patient to bed until during a severe paroxysm of cough a large amount of pus was expelled. A partial remission of symptoms would then occur. Constant semi-invalidism was her lot and its basis was considered tuberculous by all physicians who treated her. The diagnosis was strengthened by the fact that a brother died from tuberculosis during the course of our patient's illness. Repeated sputum examinations were negative for tubercle bacilli, so that her

physician finally had a radiograph of the chest made, which revealed the pin in the right lung, and he referred the case to the Bronchoscopic Clinic. Under local anesthesia we passed the bronchoscope through the mouth and located the pin in the inferior lobe of the right lung. The pin was withdrawn by forceps through the bronchoscope in three minutes and twenty-five seconds. Removal of the pin in the Bronchoscopic Clinic has been followed by rapid subsidence of the symptoms and a complete recovery. The aspiration

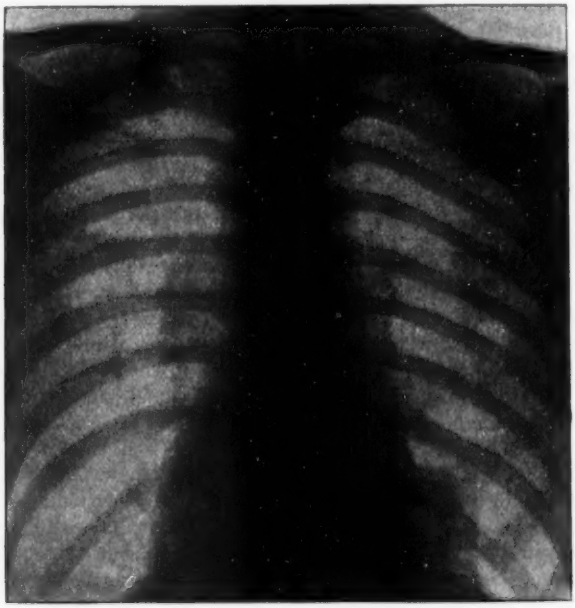

FIG. 9.—Case No. Fbdy. 726. Roentgenogram showing shawl-pin in lung of a woman, aged forty-one years. The pin produced a complete tuberculous syndrome, including copious hemoptysis. Sojourn of foreign body about twenty-eight years. Pin removed through the mouth in three minutes twenty-five seconds by bronchoscopy under local anesthesia. Complete recovery followed.

of the pin at the age of thirteen had been forgotten until it was brought to mind by the radiograph and the record in the father's diary, by which the date was fixed, was searched for and found.

In none of the foreign body cases coming under our observation have tubercle bacilli been found in the sputum. We have come to consider the finding of tubercle bacilli in the sputum, in a chronic chest condition suspected of being due to a non-opaque bronchial foreign body, to be a marked negative factor on the foreign body side of the question. This does not seem logically justifiable in

view of the fact that it is possible for a tuberculous individual to aspirate a foreign body; but the coëxistence of the two has not been met in the entire experience of the Bronchoscopic Clinic.

Fever is a variable symptom in bronchial foreign bodies. With organic foreign bodies, especially peanut-kernels, there is, in the younger patients, marked febrile reaction. The temperature chart shows an irregular course, with the maximum from 102° to 104°. The pulse-rate is usually relatively higher than the temperature, as would be expected from the dyspnea usually present. The respiratory rate increases in proportion to the degree of dyspnea present. Temperature rise is rarely associated with the presence of metallic foreign bodies until extensive inflammatory changes and secondary purulent processes have developed. The history of periodic attacks of fever, chills and malaise suggest the accumulation of pus in an abscess cavity, the spontaneous drainage of which by expectoration relieves the symptoms until refilling occurs. As pointed out by George L. Richards this sequence should always suggest foreign body in the lung. The febrile attacks usually recur with increasing frequency; the quantity of the pus accumulation usually becomes greater and finally offensive in odor, due to saprophytic changes in the pus. Bacteriologic examination of the sputum has revealed all of the usual respiratory-tract organisms except the tubercle bacilli. Bacilli of the colon group frequently account for the odor.

Night-sweats are common in the chronic septic foreign body cases. In fact all of the symptoms of tuberculosis are simulated with such exactitude that the older observers, before the days of knowledge of the specific bacteriologic cause, were fully justified in their statements that retained bronchial foreign bodies caused death from phthisis pulmonalis.

Clubbed Fingers and Toes and Incurving of the Finger-nails are frequently seen in prolonged foreign-body sojourn (see Figs. 10 and 11).

Emaciation is progressive, as a rule, when abscess or bronchiectatic cavity formation is present, yet this is subject to the same variation as in tuberculosis. Rest and a general antituberculous regimen will improve the general condition greatly; gain in weight, cessation of fever and lessening of cough will result, only to be lost again when active life is resumed. As an instance of the fluctuation of the symptoms we may cite the case of one patient (Case No. Fbdy, 608, Fig. 12), who had carried a beef bone in his lung for eleven years, gained fifteen pounds in weight during the seven months before coming to the Bronchoscopic Clinic by the antituberculous regimen of a California sanitarium. Of course, after the removal of the bone gain in weight was much more rapid, but the gain while the foreign body was still in the lung illustrates the important diagnostic point that gain in weight does not negative foreign body.

Opening of the abscess into the pleura, forming a pyopneumothorax, is an unfortunate accident which sometimes occurs—the

foreign body rarely follows the pus into the pleural cavity. Usually it is fixed in its bed by adhesions.

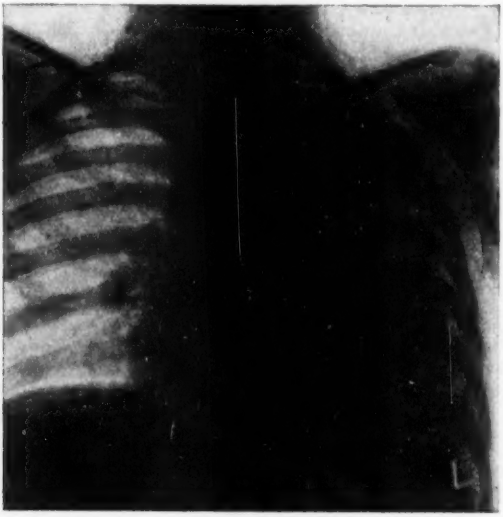

FIG. 10.—Case No. Fbdy. 679. Roentgenogram showing intubation tube in left lung of a boy, aged seven years, where it had been unsuspected for a year and a half. Diagnosis incidental to radiography for chest disease by Dr. Wagner, of the Nesbit West Side Hospital, Kingston, Pa. Faint asthmatoid wheeze present.

FIG. 11.—From a photograph showing the fingers and toes of Case No. Fbdy. 679 (Fig. 10). This clubbing is a symptom calling for the diagnostic exclusion of a foreign body in every case. In this patient it was part of a syndrome simulating tuberculosis minus the presence of tubercle bacillus. Peroral bronchoscopic removal of an intubation tube from left bronchus without anesthesia required three minutes and fifty-nine seconds, and resulted in complete recovery.

Leukocytosis, as with pus conditions elsewhere in the organism, is found with prolonged foreign body sojourn and also with the acute symptoms manifested when irritating foreign bodies are aspirated into the bronchus. The presence of an increased leukocyte count may be of differential diagnostic value in lung conditions when tuberculosis is to be ruled out, for in tuberculosis a leukopenia is the picture most frequently seen. The association of a moderate leukocytosis with prolonged sojourn of a foreign body has been noted by George L. Richards,[8] in a case in which he made a diagnosis of foreign body in the lung in the absence of a foreign body history.

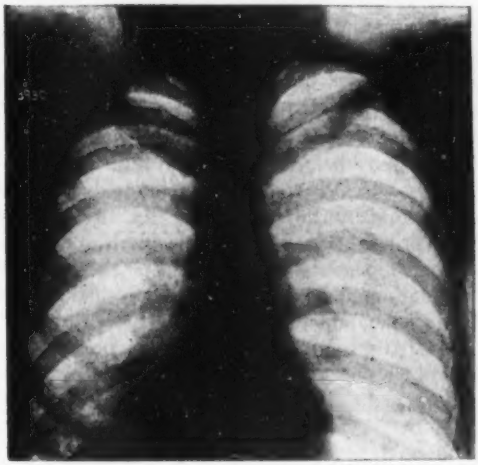

FIG. 12.—Case No. Fbdy. 608. Bone in right bronchus of boy aged twenty years. Probable sojourn eleven years. Note pathology in right lower lobe. Clinical appearances were those of tuberculosis and the patient spent many months in sanitaria for tuberculosis. Bone removed by peroral bronchoscopy, under local anesthesia in five minutes and forty-five seconds. Complete recovery.

Symptoms Due to a Previous Bronchoscopy. As pointed out by H. T. Price,[9] it is necessary in some cases to distinguish between symptoms due to foreign body in the lung and symptoms due to inexperienced, violent endoscopic or blind attempts at removal. Patients, especially children, often arrive at the Bronchoscopic Clinic with a temperature ranging from 100° to 106° F., some with cough, expectoration, subcutaneous cervical emphysema, pneumothorax, etc., resulting from heavy-handed violent use of endoscopic tubes. These patients or the relatives are told that a few days rest

[8] Foreign Body in the Lung, Proc. Am. Laryngol. Soc., 1915.

[9] Clinical Findings of Foreign Body in the Air Passages of Children, Pennsylvania Med. Jour., December, 1915.

are needed between endoscopies; but one cannot escape wonder at the evidence of lack of realization of the delicacy of structure of the air and food passages. Unless pneumothorax, mediastinal emphysema, sepsis or other serious lesions are present the reaction soon subsides with the foreign body still *in situ*, showing that the foreign body was not the cause of the symptoms. A child may be very hoarse and "croupy" from trauma inflicted by the parent's digital attempts at removal of a foreign body that may or may not be or have been present.

DIAGNOSIS OF BRONCHIAL FOREIGN BODY.

The history and mentioned symptoms may indicate clearly the foreign body etiology of the disturbance in the air-passages, but physical and roentgenologic examinations are essential to confirm the inference and to localize the intruder. It is best to study routinely and carefully the physical signs in the chest and to localize the foreign body thereby before roentgenographic studies are made—this even in those cases in which the foreign body is certain to make a clear-cut shadow in the ray plate. By the information thus obtained Spencer has been able to localize with wonderful exactness, as verified when I passed the bronchoscope to remove the foreign body, the non-radiopaque objects whose only shadow, if any, is that of the pathology incident to their presence.

Inspection. If the foreign body has been present for some time a contraction of the chest on the affected side is usually noted. The longer the sojourn of the foreign body the more marked the contraction and asymmetry. In recent arachidic cases, however, it has at times been observed by Spencer[10] that the obstructed side was fuller and that other physical signs and radiographic study by Manges[11] revealed more air than on the invaded side, a phenomenon first note by Iglauer.[12] At the Bronchoscopic Clinic we have come to regard this monolateral emphysema of the obstructed side as diagnostic of peanut-kernels in the lung. The frequence of the occurrence in peanut cases is probably explained by the shape of the peanut-kernel and the fact that the intense localized inflammatory reaction aids in narrowing the lumen. It has seemed to me from observation of foreign bodies as seen bronchoscopically *in situ* before removal that this is not due to a flapping of the foreign body, but rather to the fact that during inspiration the bronchi expand and elongate allowing air to pass on the flat side of the obstructing peanut-kernel, but the shortening and contraction of the bronchi

[10] Jackson, Chevalier, Spencer, William H., and Manges, W. F.: The Diagnosis and Localization of Non-opaque Foreign Bodies in the Bronchi, Am. Jour. Roentgenol., June, 1920, No. 6, vol. vii.

[11] Ibid.

[12] Three Cases of Foreign Body in the Bronchi, Lancet-Clinic, June 1, 1912, No. 22, vol. cii.

during expiration prevent the exit of the air, and, as a consequence, air under pressure is constantly maintained on the obstructed side—an acute obstructive emphysema. This phenomenon is observed, with other objects which set up marked localized inflammation as, for instance, composition buttons and grains of maize. It has also been observed in cases of foreign bodies too small, relatively to the size of the invaded bronchi to cause obstruction solely by bulk. Whether this implies a degree of spasm or not I am unable to say positively. A few cases seemed to show spasm; but the presence of the tube excites spasmodic contraction, which with the alterations of lumen outline associated with the bechic, respiratory and pulsatory movements renders recognition of spasm as a separate entity difficult.

Inspiratory retraction of the interspaces is sometimes observed to be marked on the obstructed side.

Expansion as observed by Thomas McCrae[13] is more or less limited on the side in which the bronchial foreign body is lodged. It is present even with such small objects as a common straight pin which could obstruct only the smallest bronchi. The limitation of movement becomes more marked as the degree of bronchial obstruction is increased, until with complete obstruction of one lung, respiratory movements are absent on that side.

For the following consideration of physical signs, the author, being unable to present the subject, is indebted to William H. Spencer, who has had the unparalleled opportunity to study the physical signs of all the foreign body cases that came to the Bronchoscopic Clinic in the last three years.

Palpation. Rhoncal fremitus is often of valuable localizing aid. When there exists but partial obstruction in a large bronchus the vibrations are usually most intense posteriorly, over the site of the foreign body. With complete occlusion of a bronchus, however, rhoncal fremitus, if present, will be on the unobstructed side. Vocal fremitus in acute bronchial obstruction is but little if at all altered. With the development of drowned lung and other pathology the tactile appreciation of the voice sounds is diminished.

Percussion. The note obtained in an acute obstruction of a bronchus is of a muffled tympanitic quality—corresponding to the note of a drum which has its air-vent plugged. This curious muffled tympanitic note is most striking in the arachidic cases, in which air under moderate pressure is maintained on the affected side, due to the valve-like action explained under "Inspection," which allows the entrance but delays the exit of air. As secretions accumulate in the air-passages distal to the obstruction, increasing dulness is found, until over an area of drowned lung the percussion note is flat. With partial obstruction of a bronchus there is always

[13] The Physicial Signs of Foreign Bodies in the Bronchi, Am. Jour. Med. Sc., March, 1920, No. 3, clix, 313.

impairment of resonance distal to the foreign body due to pathologic changes caused by interference with drainage and aëration.

Auscultation. The evidence furnished the ear of the examiner is perhaps the most conclusive part of the examination. The stethoscope correlates the other physical findings and helps us to interpret them correctly. By placing the ear at the open mouth of the patient (not at the chest wall) and requesting a forced expiration one may in certain cases elicit the "asthmatoid wheeze,"[14] which is a most valuable aid in deciding the presence or absence of a bronchial foreign body which does not show in the radiograph. As the name implies the wheeze has an asthma-like quality, but is dryer and is best heard during a forced expiration after the bronchi have been coughed free from secretion. It may be so loud as to be heard at a distance of several feet or even in the next room. Thomas McCrae listens for it by placing the bell-mouth of the stethoscope at the patient's open mouth. The term "asthmatoid" refers not to similar etiology or mechanism but to similar sound.

The most constant auscultatory finding is diminished intensity of the respiratory murmur distal to the foreign body. If there be complete occlusion of the bronchus breath sounds are absent below the obstruction. Curiously, vocal resonance is usually but little altered in acute obstruction of a bronchus. Later when "drowned lung" or pulmonary abscess is present the vocal resonance is diminished on the affected side.

The presence and location of rales are of great diagnostic significance. A diffuse tracheobronchitis as seen with organic foreign bodies will be denoted by scattered, loud, snoring, snapping and cracking sounds. These sounds will be most intense on the free side because the presence of the foreign body and the swelling prevents the to-and-fro passage of air on the obstructed side which is necessary to their production. When air can pass an obstruction in the bronchus, rales are formed at this site and can be heard most distinctly posteriorly at the corresponding location on the chest wall. These vibrations are transferred to other parts of the chest, but their greatest intensity is at the point of obstruction.

Occasionally one hears rales of a "tissue-paper" variety over the site of lodgment of a foreign body. These fine crackles and limitation of expansion on one side of the chest were the only physical signs present in a young woman who had aspirated a dental broach while in the dentist's chair (Case No. Fbdy. 683). Vocal resonance like vocal fremitus is usually normal until inflammatory changes or retention of secretion impairs its transmission.

The syndrome of limited expansion, impaired percussion note and absent breath and voice sounds has led many an able observer inexperienced in foreign-body cases to interpret the condition as

[14] Jackson, Chevalier: A New Diagnostic Sign of Foreign Body in Trachea or Bronchi, the "Asthmatoid Wheeze," Am. Jour. Med. Sc., November, 1918, No. 5, clvi, 625.

empyema. Rib resection has been needlessly performed on many patients who afterward came to the Clinic; the pleura, however, had invariably been found to be normal. In many of these cases the foreign-body history had been deliberately ignored by the surgeon, who did not even think it worth while to have a radiograph taken in cases of tacks, nails and other metallic objects.

The characteristic physical signs of an acute bronchial obstruction by a foreign body are limited expansion, muffled tympanitic percussion note and diminished or absent breath sounds on the obstructed side. Vocal resonance and fremitus are but little altered.

Prolonged bronchial obstruction is evidenced by limited expansion, dull or flat percussion note over the base of the lung, diminished or absent breath sounds over that portion of the lung distal to the foreign body and impaired vocal resonance and fremitus. The location of the lesion in the base of the lung should rule out tuberculosis, for tuberculous involvement of the base of one lung is practically never encountered. The presence of the asthmatoid wheeze is one of the most valuable confirmatory signs; its absence, however, by no means negatives the presence of a foreign body in the bronchus.

Roentgen-ray Examination. After an independent localization by physical signs the foreign body is localized with the fluoroscope and roentgenogram. The best roentgen-ray work is essential. The roentgenologist is given the salient points of the history and the findings and inferences of the examiner of the chest, so that they may work together instead of as separate and sometimes antagonistic units. It is important that both lateral and anteroposterior roentgenograms be made, for an object may not show if it overlay the shadow of the spine, or a flat object, such as a bone lying in the lateral body plane, might be invisible in the anteroposterior view; but the increase in density due to the greater mass through which the rays must pass in the lateral plane in which the foreign body may be edgewise to the rays may cause a definite and clear-cut shadow. At this point it is well to mention the great value of a roentgenogram after the removal of the foreign body, for there may have been two foreign bodies present and but one removed. An instance of this might be cited in which the radiograph showed a coin, but two coins perfectly apposed were removed. Had there occurred a displacement of the approximation of the two coins and but one been removed a continuance of the symptoms would have cast doubt on the operator which would be confirmed beyond explanation by a tardy radiograph, and, worse than all, the patient would have been unrelieved.

Until recently the roentgenologist has depended upon pathologic shadows in the localization of recent bronchial foreign bodies not opaque to the roentgen ray but Willis F. Manges[15] working in

[15] Jackson, Chevalier, Spencer, William H., and Manges, W. F.: The Diagnosis and Localization of Non-opaque Foreign Bodies in the Bronchi, Am. Jour. Roentgenol., June, 1920, No. 6, vol. vii.

conjunction with William H. Spencer on the material coming to the Bronchoscopic Clinic and considering the physical and the ray findings in consultation has been able to demonstrate clearly on the plate certain signs which fully fit the physical findings in these

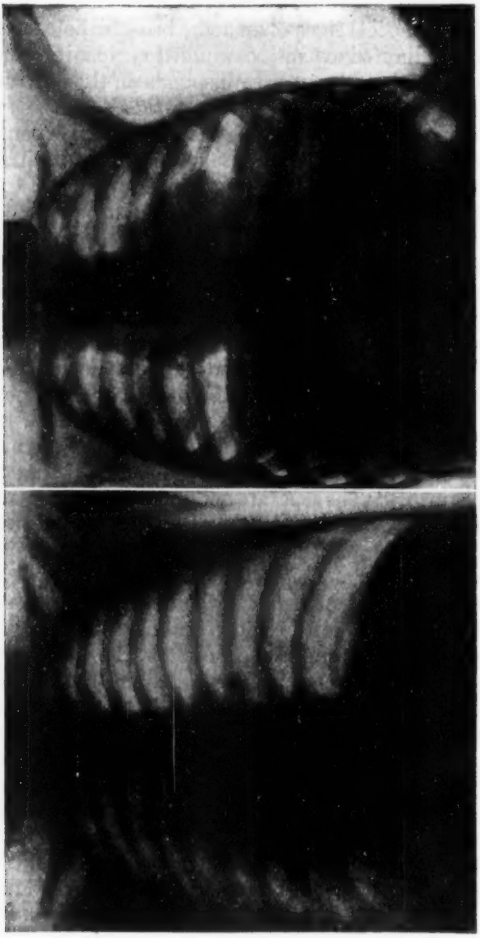

FIG. 13b.—Note disappearance of the signs two days after removal of peanut kernel from the right main bronchus.

FIG. 13a.—Case No. Fbdy. 727. Peanut kernel in right main bronchus. Asthmatoid wheeze present. Note the depression of the right diaphragm, displacement of heart and mediastinum to the left and increased transparency of the whole right chest.

puzzling cases which are mostly of the nut kernel group. These radiographic findings are:

1. Increased transparency on the obstructed side.
2. Displacement of the heart toward the uninvaded side.

3. Downward displacement of the diaphragm and a marked limitation of its motion on the obstructed side. In short, an acute, monolateral obstructive emphysema (Figs. 8 and 13). It is the monolateral character that is especially valuable diagnostically. Bilateral emphysema is less easily detected and is of little significance because it occurs in various conditions. As the obstruction continues accumulation of secretion (drowned lung) and coincident inflammatory reaction make clear-cut shadows distal to the foreign body, rendering the diagnosis easy; but to wait for these signs in arachidic cases might be fatal to the patient. Iglauer[16] was the first to report a case in which the location of a non-opaque foreign body was erroneously interpreted in the radiograph because the foreign body had, by a valve-like action, imprisoned more air in the obstructed side, so that there was shown a very marked emphysema on that side.

The Differential Diagnosis between Tracheal and Esophageal Foreign Bodies is sometimes a point of seeming difficulty to the roentgenologist of limited foreign body experience. The value of a lateral view is here most clear, for one can see the trachea outlined plainly in a well-made plate. Furthermore, it does not seem to be generally known, and therefore it will bear repetition (see *Peroral Endoscopy and Laryngeal Surgery*, p. 226) that disk-shaped foreign bodies seen in the ray to be lying in the sagittal plane must be in the trachea, for they must have entered through the anteroposterior chink of the glottis, and, furthermore, can only remain in that position because the trachea is an open tube with a yielding posterior membranous wall. A disk in order to enter the esophagus must pass flatwise behind the larynx and enter the anteroposteriorly collapsed cervical esophagus in the same position, therefore it will be seen lying in the lateral body plane, usually at the level of the suprasternal notch. A radiopaque mixture can be fluoroscopically seen to pass posterior to the tracheal foreign body, whereas the opaque stream can be seen to divide and pass both anteriorly and posteriorly to an esophageally lodged foreign body.

In order to localize a branch bronchus invaded by a small foreign body the bronchoscopic insufflation of dry bismuth subcarbonate has been of considerable aid.[17] It is not easy to introduce radiopaque substances into the smaller bronchi by injection through the larynx only, for such substances are liable to be promptly coughed out, usually before they reach the carina. By bronchoscopic introduction, however, the opaque substances remain long enough for fluoroscopic and roentgenographic study. A stereoscopic pair of plates will give a beautiful picture of the tree normal or abnormal.

[16] Three Cases of Foreign Body in the Bronchi, Lancet-Clinic, June 1, 1912, No. 22, vol. cii.

[17] Jackson, Chevalier: The Bronchial Tree: Its Study by Insufflation of Opaque Substances in the Living, Proc. Am. Laryngol. Assn., 1918; also Am. Jour. Roentgenol., October, 1918.

No toxic or obstructive symptoms have ever been observed to follow the intrabronchial application of the bismuth; radiographic examination showed all of it to have been removed by the ciliary and bechic forces twenty-four hours after its insufflation.

Needles, small headed pins and such objects get very far down and very far out toward the periphery of the lung and into a very small branch bronchus, of which there are many. To search all of these with a probe or minute tube consumes a large amount of time. The positive transparent films of the tracheobronchial tree devised by the author[18] when laid over the negative of the patient will show the foreign body through the transparent tracheobronchial tree and indicate the invaded bronchus. In placing the film, bony landmarks are not reliable because of the wide variation due to the phylogenetic recency of the upright posture. Visceral landmarks are necessary. The two important visceral landmarks are the dome of the pleura and the dome of the diaphragm. Twelve photographic enlargements and reductions are on hand so that a film of the size (rather than the age) is available for any patient, the size being chosen by matching the distance between the dome of the pleura and that of the diaphragm as shown in the radiograph of the patient. To prevent error in the use of these films it is necessary to guard against false localization due to displacement of the lung by atelectasis and especially by compensatory emphysema on the other side.

A negative radiographic report while valuable, if based upon a good plate and given by a roentgenologist of experience, does not exclude the presence of a foreign body, because the thickness of the chest wall, lack of density of the foreign body, faulty technic or inferior roentgenographic apparatus, intractability of the patient or what not may prevent the making of clear-cut plates. The pathology caused by a foreign body will, however, soon make itself manifest and is usually easily recognized in the roentgenogram. As before mentioned, however, to wait for these signs to appear might be of serious consequence to the patient. If the history, symptoms and physical signs are present we must therefore disregard the negative ray findings and proceed with the endoscopic search for the foreign body.

FOREIGN BODY IN THE PHARYNX.

Fish bones are perhaps the most frequent of pharyngeal foreign bodies, and they, as do other thin, sharp objects, lodge most frequently in the crypts of the faucial or lingual tonsillar masses. The subjective localization of the object by the patient is usually rather vague, although the side on which the object lies can usually be designated. Pain of a "sticking" character is the usual complaint with pointed objects. Swallowing increases the discomfort,

[18] Peroral Endoscopy and Laryngeal Surgery, text-book, 1914.

and because of this the patient often refrains from eating. In his student days the author himself had a bone of a reed-bird lodge on the posterior surface of his left tonsil. It was not visible on inspection, but was found by Charles E. de M. Sajous by palpation with the index finger and removed digitally. Large foreign bodies such as tooth plates, boluses of meat and even live fish have been known to suffocate the patient. This is so well known that students are taught in their course in internal medicine to search the pharynx for foreign objects in all cases of coma. A foreign body may be coughed from the lower air passages into the nasopharynx and be overlooked for some time unless this possibility be considered.

If the object be lodged near the larynx, violent coughing may result. Vomiting and retching often occur early but cease rather soon. Examination should show the foreign body, but rather close scrutiny may be necessary to find a small fish bone. Blind efforts at removal are never justified and much mutilation can be done by groping about with forceps and fingers. Culp[19] reports the interesting case of the removal, from the sublingual sinus near its attachment to the epiglottis, of a needle which was said by the patient to have entered the left knee eleven years before while she was scrubbing the floor. In the literature there are reports of a number of cases of wandering foreign bodies that have been removed from remote tissues years after entrance from the food passages, but none from the air-passages proper.

In the diagnosis of a foreign body in the pharynx the following points are worth remembering: Pharyngeal foreign bodies are usually readily located by the patient from subjective sensation and by direct inspection by the surgeon. Thin, sharp objects usually lodge in the tonsillar masses. The possibility of lodgment in the nasopharynx must be kept in mind. The roentgen ray, inspection and palpation are the most important means of diagnosis. The roentgen-ray work must be done by an expert with the very best equipment; inspection requires good illumination with head mirror or head lamp and laryngeal and postnasal mirrors to look "around the corner," back of the tongue, tonsils, pillars, velum, etc. Palpation by the index finger is essential when other means are negative, but the palpation must be gentle and the surgeon must be familiar with the feeling of the various structures. The author has seen cases in which one cornu of the hyoid bone was felt and denuded in blind attempts at forceps removal of a supposed bone for which the cornu of the hyoid bone was mistaken.

FOREIGN BODY IN THE ESOPHAGUS.

Dysphagia, Odynophagia and Subjective Sensation of a Foreign Body. Dysphagia is the most prominent symptom of esophageal

[19] Laryngoscope, 1919, xxix, 292.

foreign bodies, varying in degree with the size of the intruder, the degree of spasm and inflammatory reaction it induces. Complete obstruction is most often seen when a meat bolus becomes impacted at the mouth of the esophagus. A very small foreign body may cause regurgitation and complete inability to swallow even water. This *complete occlusion* may be due to spasm, swelling of the esophageal walls, augmentation of the size of the foreign body by expansion with absorbed moisture or by accumulation of food about the intruder. Coins may cause intermittent occlusion by tilting. Intermittent occlusion may also be due to lodgment of food above the intruder. On the other hand a foreign body of long sojourn may cause no appreciable dysphagia. The subjective sensation of foreign body and of obstruction is commonly present, although in children it may be overlooked. In some cases the localization of the patient is correct, in other cases the sensation may be reflected from the present location or may be the site of a previous location. Sharp, foreign bodies at the hiatus are often felt by the patient in the neighborhood of the ensiform cartilage. Pain is present when large objects are impacted or when pointed foreign bodies penetrate the walls of the esophagus. When cervical periesophageal inflammation exists there is usually marked tenderness and pain on swallowing. Substernal aching is not an infrequent complaint when objects are lodged in the thoracic esophagus and painful spasm at the hiatus may be caused by a foreign body or an erosion produced thereby. Pain and the subjective sensation of foreign body are, however, not dependable signs of the actual presence of a foreign body if there does not exist a coincident dysphagia; and it must be remembered that difficulty in swallowing may be imaginary. Abrasions and inflammation caused by the temporary lodgment of a foreign body in the esophagus may create and maintain the pain, subjective foreign body sensation and even dysphagia for a time after the passage of the object. These symptoms subside in a short time and will be greatly relieved by the administration of bismuth subnitrate, preferably with calomel for the first few doses, dry on the tongue, for its protective and slightly antiseptic action.

Excessive Salivation usually accompanies complete occlusion of the esophagus by a foreign body and is very distressing, causing drooling or constant expectoration, and cough by overflow into the larynx.

Dyspnea may be a symptom of an esophageal foreign body which because of its size produces compression of the trachea, or of a pharyngeal foreign body overhanging the larynx. It is well to bear in mind that dyspnea and hoarseness may be present from previous attempts at removal by parents or practitioners. Many such cases have come to the clinic, some of them without any foreign body being present. *Cough* is an important symptom in some esophageal cases and may be due to overflow of secretions into the larynx, or to

perforation, traumatic or ulcerative, of the party wall, allowing leakage of food or secretions into the trachea. In a few instances it has seemed to be of reflex origin.

Hematemesis and Hemoptysis are not uncommon, and if the foreign body penetrate a large vessel fatal hemorrhage may result.

Wry-neck. Holding the head on one side we have noticed in a number of cases coming to the clinic usually in very young children. In one such instance a boy was sent to F. F. Borzell for suspected disease of the shoulder-joint. Borzell fluoroscopically found a coin in the esophagus.

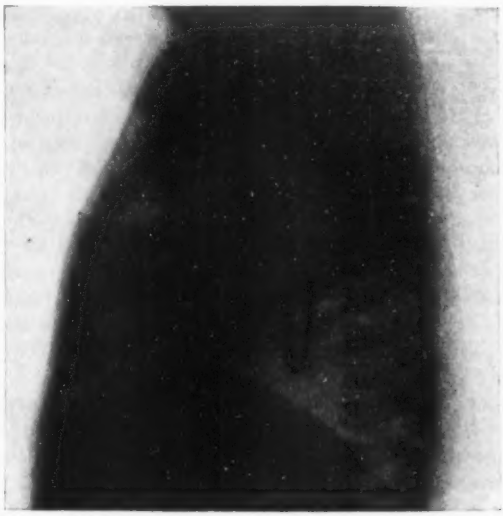

FIG. 14.—Case No. Fbdy. 695. Open safety-pin in the esophagus regurgitated after a seven weeks' sojourn in the stomach. Pointed shaft buried in the anterior wall of the esophagus up to the spring. Point directed toward the pericardium. Child admitted, with temperature of 106°. Complete recovery after esophagoscopic removal.

Fever is often present in children. One very interesting case (Case No. Fbdy. 695, Fig. 14) was that of a child of nine months who had swallowed an open safety-pin which had remained in the stomach two months and was then regurgitated into the esophagus. The point had penetrated the esophageal wall and was pointing toward the pericardium. The patient was extremely toxic and had a temperature of 106.° The temperature fell immediately on removal of the pin, showing that it had been the cause of the disturbance. Recovery was prompt and complete.

Roentgenography and Fluoroscopy. If the object be radiopaque it will readily be seen in the fluoroscopic study and on the radio-

graph. Anteroposterior and lateral studies should be made. Roentgenograms often show foreign bodies invisible in the fluoroscope. A small plate low down on the neck close to the clavicle often shows a foreign body invisible in the anterioposterior plate. If the foreign body be not of sufficient density to show with the roentgen ray the point of obstruction can be demonstrated fluoroscopically by having the patient swallow some barium mixture or, better still, by watching the progress of a barium-filled capsule, as urged by Ellen J. Patterson. The capsule will lodge at the site of lodgment of the foreign body and on slowly dissolving may outline the intruder. It is necessary for the fluoroscopist to be familiar with the hesitations often seen in cases with a perfectly normal esophagus. Interpretation of the radiograph must be by the roentgenologist, and none but the very best plates are of any value negatively. Over and over again foreign bodies have been found in good plates after negative opinions had been given, prior to admission, on the basis of poor plates. The most common site of lodgment is at the superior aperture of the thorax, where flat objects are seen lying in the lateral plane of the body. Once dislodged from this location foreign bodies are liable to go downward into the stomach provided they are not too large to pass through the hiatus esophageus. It has been our observation that if a foreign body passes unaided through the hiatus it will usually go through the pylorus and be expelled per rectum. For localization it is sometimes necessary to insufflate bismuth subcarbonate into the bronchi so they will cast a shadow.[20]

Symptoms Due to Attempts at Removal of Esophageally-lodged Foreign Bodies must be differentiated from symptoms due to the intruder itself. This is of the utmost importance because, if the symptoms are due to the foreign body, as in the case of the safety-pin above mentioned, immediate removal is imperatively demanded to save the patient's life. In such cases there is little or no hope that the symptoms will subside until the intruder is removed, and the sooner it is taken out the better. On the other hand, traumatic esophagitis due to blind bouginage or inexperienced, violent or prolonged esophagoscopy, is a dangerous condition, the cure of which, if curable at all, depends on rest and quiet, with bismuth and calomel dry on the tongue, fluid diet, etc. To esophagoscope a lacerated inflamed edematous esophagus in search of a foreign body is to court both failure and disaster. The usual symptoms of traumatic esophagitis are dysphagia, odynophagia, cervical tenderness, cervical subcutaneous emphysema most often discoverable by palpation on or near the inner end of the clavicle, foul breath, anorexia and fever. Children are often brought to the Bronchoscopic Clinic in this condition, and it is necessary to explain to the parents

[20] Jackson, Chevalier: The Bronchial Tree: Its Study by the Insufflation of Opaque Substances, Am. Jour. Roentgenology, October, 1918, v, 454.

that an interval is advisable between esophagoscopies. In one case D. R. Bowen noted the barium mixture dividing into a number of streams, which phenomenon was found at esophagoscopy to be due

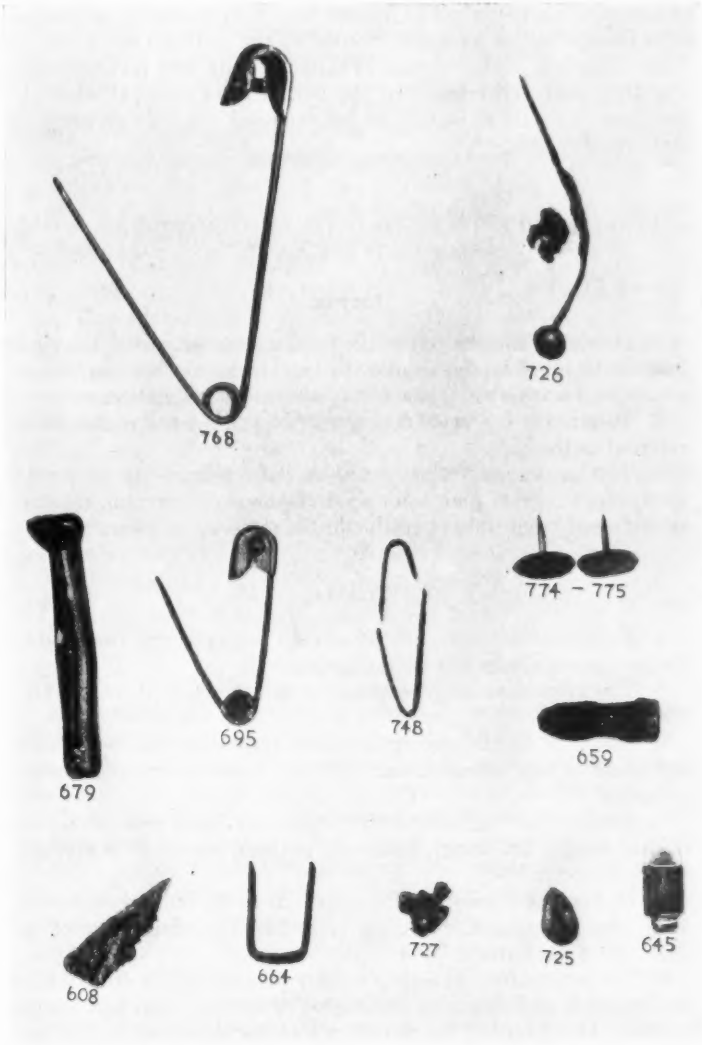

FIG. 15.—Foreign bodies removed from the air and food passages by endoscopy through the mouth in the cases shown in the preceding roentgenograms. Illustrations are actual size.

to masses of edematous mucosa looking like sessile nasal polypi and they had undoubtedly resulted from the violent prolonged inexperienced esophagoscopy done before admission. "Don't use blind instrumentation or bouginage!" should be the first words of the diagnostic discussion. The former very high mortality of esophageal foreign bodies can be attributed to the methods employed for their diagnosis and removal. Esophagoscopy has revolutionized the treatment and minimized the mortality of removal while the roentgen ray renders bouginage for diagnosis not only unnecessary but reprehensible.

SUMMARY OF THE CHIEF POINTS IN THE SYMPTOMATOLOGY AND DIAGNOSIS OF FOREIGN BODY IN THE AIR AND FOOD PASSAGES.

Larynx.

1. Foreign bodies lodged in the larynx cause an initial laryngeal spasm which is followed by more or less laryngeal wheezing, croupy cough, and a variable degree of impairment of phonation.
2. Pain in the laryngeal region may be present and is sometimes referred to the ears.
3. The larynx may tolerate a thin, flat foreign body for a relatively long period of time, but the development of increasing dyspnea renders early removal imperative in the majority of cases.

Trachea.

4. Tracheal foreign bodies are usually movable and their movements can usually be felt by the patient.
5. The vibrations may be palpated and heard with the stethoscope.
6. Cough is usually present at once, may disappear for a time and recur, or may be continuous, and may be so violent as to induce vomiting.
7. Sudden shutting off of the expiratory blast and phonation during paroxysmal cough is almost pathognomonic of a movable tracheal foreign body.
8. Dyspnea is usually present and is due to the bulk of the foreign body plus the subglottic swelling caused by the traumatism of the shiftings of the intruder.
9. The asthmatoid wheeze is usually present and is often louder and of lower pitch than the asthmatoid wheeze of bronchial foreign bodies. It is heard at the mouth, not at the chest wall.
10. Pain is not a common symptom, but may occur and be accurately localized by the patient.

EARLY SYMPTOMS OF IRRITATING FOREIGN BODY (SUCH AS A PEANUT-KERNEL) IN THE BRONCHUS.

Bronchi.

11. Initial laryngeal spasm is almost invariably present with foreign bodies of organic nature such as nut kernels, peas, beans, maize, etc.

12. A diffuse purulent laryngo-tracheo-bronchitis develops within twenty-four hours in children under two years.

13. Fever, toxemia, cyanosis, dyspnea and paroxysmal cough are promptly shown.

14. The child is unable to cough up the thick mucilaginous pus through the swollen larynx and may "drown in its own secretions" unless the offender be removed.

15. Lung abscess rapidly forms.

16. The older the child the less severe the reaction.

17. In the early stages an acute obstructive emphysema is present, manifested by: (*a*) Limited expansion, (*b*) muffled tympanitic percussion note, (*c*) markedly diminished or absent breath sounds on the obstructed side, (*d*) many rales and harsh breathing on the free side.

18. The radiograph confirms these signs by showing (*a*) greater transparency on the obstructed side, (*b*) displacement of the heart toward the free side, (*c*) depression and limitation of the diaphragmatic movement on the obstructed side.

SYMPTOMS OF PROLONGED FOREIGN BODY SOJOURN.

Bronchi.

19. The time of inhalation of a foreign body may be unknown or forgotten.

20. Cough and purulent expectoration ultimately result although there may be a protracted delusive symptomless interval.

21. Periodic attacks of fever, with chills and sweats and followed by increased coughing and the expulsion of a large amount of purulent, usually more or less foul material are so nearly diagnostic of foreign body as to call for exclusion of this probability with the utmost care.

22. Emaciation, clubbing of the fingers and toes, night-sweats, hemoptysis, in fact all of the symptoms of tuberculosis are in most cases simulated with exactitude, even to the gain in weight by an outdoor regimen.

23. Tubercle bacilli have never been found in the Bronchoscopic Clinic associated with foreign body in the bronchus. It was the only element lacking in a complete clinical picture of advanced tuber-

culosis. A point of difference was the rapid recovery after removal of the foreign body.

24. The erroneous statement in all of the text-books that foreign body is followed by phthisis pulmonalis is an heirloom of the days when the bacillary origin of true tuberculosis was unknown, hence the foreign body phthisis pulmonalis or pseudotuberculosis was confused with the true pulmonary tuberculosis of bacillary origin.

25. The subjective sensation of pain may allow the patient to localize a foreign body accurately.

26. Foreign bodies of metallic or organic nature may cause their peculiar taste in the sputum.

27. Offensive odored sputum should always suggest bronchial foreign body; but absence of sputum, odorous or not, should not exclude foreign body.

28. Sudden complete obstruction of one main bronchus does not cause noticeable dyspnea provided its fellow is functionating.

29. Complete obstruction of a bronchus is followed by rapid onset of symptoms.

30. The pleura is rarely involved. Rib resection done for supposed empyema have with one exception shown no pus.

31. The physical signs usually show limitation of expansion on the affected side, impairment of percussion, and lessened transmission or absence of breath sounds distal to the foreign body.

32. The "asthmatoid wheeze" may, if present, be of great diagnostic value. Its absence, however, does not negative the presence of foreign body.

33. All cases of chest disease should have the benefit of a radiographic study to exclude bronchial foreign body as an etiological factor, and negative opinions should never be based upon any plates except those of the utmost perfection that the wonderful modern development of the art and science of roentgenology can produce. In doubtful cases, the negative opinion should not be conclusive until a roentgenologist of long and special experience in chest work has been called in consultation. Even then there will be an occasional case calling for diagnostic bronchoscopy.

34. Symptoms of pulmonary abscess, or other lung disease, even cough, following within a few weeks of the extraction of teeth, call for the exclusion of foreign body in the lung.

Esophagus.

35. There are no absolutely diagnostic symptoms of esophageal foreign body.

36. Dysphagia, however, is the most constant complaint, varying in degree with the size of the foreign body and the degree of inflammatory or spasmodic reaction produced.

37. Pain may be caused by the penetration of a sharp foreign body, by inflammation secondary thereto, by impaction of a large object or by spasmodic closure of the hiatal sphincter.

38. The subjective sensation of foreign body is usually present but cannot be relied upon as assuring the presence of a foreign body for it is present for a time after the passage of the intruder.

39. All of these symptoms may exist, often in most intense degree, from previous violent attempts at removal and the foreign body may or may not be present.

40. Fluoroscopic study of the swallowing function with barium mixture or capsule will give the location of a foreign body which may not be radiopaque.

41. Anteroposterior and lateral roentgenograms should always be made.

42. The value of a radiograph after the removal of the foreign body cannot be too strongly emphasized.

Stomach.

Foreign body in the stomach ordinarily produces no symptoms. The roentgenogram and the fluoroscopic study with an opaque mixture are the chief means of diagnosis.

CANCER OF THE UTERUS.[1]

By John B. Deaver, M.D.,
PHILADELPHIA, PA.

With a Description of the Pathology.

By Stanley P. Reimann, M.D.,
DIRECTOR OF THE LABORATORY, LANKENAU HOSPITAL, PHILADELPHIA, PA.

Very often it must seem as though the pursuit of the cancer problem were like chasing the elusive will o' the wisp. But the vocabulary of the scientists contains no such word as fail, and surely some day the solution will be at hand. It may burst upon us from some hitherto unsuspected source, but it is sure to come, for it is inconceivable that all the investigations that are devoted to this subject should be fruitless. Without an exact knowledge of the causative factor of cancer we cannot, of course, expect to prevent its development; but until that time arrives no means of mitigating its evil should be untried. There are not a few indications that the

[1] Read before the Southern Surgical Association, Hot Springs, Va., December 15, 1920.

surgeon may be asked to lay down his knife as far as cancer, more especially cancer of the uterus, is concerned and make room for radiotherapy, either roentgen ray or radium, or what seems the most satisfactory method, a combination of the two.

One of our English colleagues in discussing these methods in the treatment of uterine fibroma laconically remarks, "When the pen has superseded the sword the scalpel will still be needed for myoma." I believe this also applies to cancer of the uterus in spite of the very gratifying reports concerning the non-operative treatment of these cases.

As in all types of disease the demand for early recognition of cancer and of precancerous changes is imperative. But we are confronted with the question, is early diagnosis possible? If the answer to this question cannot be definitely positive it can at least be said that certain clinical phenomena are suggestive and sufficiently so to command attention. Among such suggestive clinical signs may be mentioned intermenstrual bleeding, increase in quantity, duration and periodicity of the menstrual period in the active uterus, especially at the onset of the menopause, and a bloody discharge after the latter has been established. The character of bleeding between periods may vary from a slight discharge from what might be termed hemorrhage, and is usually excited by irritation, as during urination, defecation or by examination or manipulation. The latter particularly should arouse suspicion, as it is in all probability due to erosion of capillary vessels influenced by the tumor cells.

The character of the vaginal discharge is also suggestive. In the incipient stage of cancer it may differ from the normal only in amount or it may be serosanguineous, but it is usually in a later stage that it becomes distinctly blood-stained while in the advanced stage it is purulent and foul-smelling.

As in nearly all forms of internal cancer, pain is, unfortunately, not an early symptom of uterine cancer. Indeed, owing as much as anything to the poor supply of sensitive nerves in the cervix and the body of the uterus, pain is an indication of infiltration beyond the uterine limits and is thus a most discouraging sign. But, as I have said, these signs are merely suggestive—diagnosis must rest on careful inspection and digital and microscopic examination. The latter is of the utmost importance. That is to say, careful examination of the products of curettage or an excised portion of the cervix is of immeasurable value as a diagnostic aid in detecting carcinoma that might otherwise be overlooked. If only one case in a hundred thus examined prove positive for carcinoma the procedure is justified. Curettage should include the body and fundus as well as the cervix. The predominance of cancer in the cervical portion of the uterus is well known. This fact is of importance in the association of carcinoma and fibromyoma. For this reason chiefly,

and also to prevent an obstinate future vaginal discharge, it is my practice in all cases of fibromyoma of the uterus approaching the menopause, in the menopause or after the menopause to do a complete removal. Statistics show that 2 or 3 per cent. of myoma uteri are associated with carcinoma of the cervix. It is readily seen that in precisely that proportion of cases the examination of cervical scrapings with positive results will indicate a total hysterectomy where otherwise a subtotal operation might have been done, thus contributing to the list of cases of cancer of the cervix developing after a supravaginal hysterectomy.

Curettement, however, has its serious limitations, inasmuch as material taken from one portion of the uterus may be entirely free from suspicion while malignancy may possibly be lurking in another part. In view of this it seems to me that the more rational method of obtaining information would be by direct inspection by means of a hysterotomy, a method which I have advocated on many occasions and practised with entire satisfaction. It is an open method, and in this consists its greatest advantage.

It is perhaps a fortunate thing, from a diagnostic standpoint, that the cervix is the more common site of uterine carcinoma, and it is important in this connection that in this location it spreads very rapidly, causes earlier fixation of the uterus and extension into the broad ligaments and walls of the vagina. Of value also is the fact that carcinoma of the cervix in the vast majority of cases develops in women who have had children. Very often there is present a laceration not entirely healed and presenting a reddened, eroded surface covered with a discharge and giving evidence of chronic inflammation. The pathologist sees in these cervices ulceration of the mucosa, irregularities in the epithelium covering the edges of these erosions, dense, scar tissue distorting and ensnaring epithelial cells piled on the lining, cystic dilatation of the glands with distortion of the lining epithelium and the like. It is not at all unusual for me to receive pathological reports which read: "Cannot tell whether this is carcinoma or not, but it may be." In such instances I do not hesitate a moment about removing the uterus. Curettage or any other time-wasting procedure has no place here. Certainly, I also remove a portion of the cervix for microscopic study.

The pathological changes that lead to cancer of the body and the fundus of the uterus are not so clear. But there are certain evidences of glandular hypertrophy, excessive secretion and desquamation with subsequent hyperplasia of lining cells which are, to say the least, suggestive of precancerous conditions.

When I do a hysterotomy I notice, of course, great shagginess, ulceration, fragile hemorrhagic endometrium, but also on the line of incision or any suspicious looking area I look for a sharp line of demarcation between endometrium and musculature. Very often normally there are a few glands beyond the line of the endometrium,

but in general the dividing line is fairly sharp. Whenever I see tissue like endometrium invading the musculature I am suspicious and do not hesitate to give the patient the benefit of the doubt.

In the presence of undoubted cancer, complete hysterectomy is probably as sure a means of curing the disease as we have, provided, of course, that the growth is not so far advanced as to threaten adjacent tissues. It is these cases also that the radiologist believes are the most amenable to their treatment. This may be so, but it has not been my experience. I have too often seen an apparent regression of the tumor for several months after radium treatment, only then to be confronted with evidence of recurrence. This may possibly be due to faulty technic, but the same holds good, to a large extent, with regard to surgical failures. There is, however, less excuse for the latter, since the technic of the operation enjoys a certain degree of perfection, although at the same time it requires skill and experience. Radiotherapy, on the other hand, may be said to be still in its formative period, but its technic is probably more easily acquired. The gist of the matter no doubt is that the tyro in either method helps to discredit the one as he does the other.

Unfortunately the surgeon so frequently sees the baneful effects of radiotherapy in cases that were either mishandled or unsuitable for the treatment that it is only natural that he should not sing its praises in loud tones. Not long ago I had occasion to operate upon a woman who, under a diagnosis of cancer of the uterus, had been treated elsewhere with radium, the dosage and time of exposure of which I do not know. She was brought to the Lankenau Hospital with evidence of peritonitis and an abscess in the cul-de-sac. I drained the abscess and did a hysterectomy. The woman died two months later following a stormy, septic course. Autopsy showed sloughing masses in the sigmoid, perforations, etc. No evidence whatever of carcinoma could be found in spite of the most painstaking search and section study of the uterus. The pathological diagnosis consisted of a small subserous myoma. This, of course, is a case of mistaken diagnosis and in no way reflects on the efficiency of radium, but it does illustrate the dangers of its use in inexperienced hands.

On the other hand the pathologist of the Lankenau Hospital, Dr. Stanley P. Reimann, has made a study of uteri removed, surgically, from one to five weeks after treatment with radiation. Of two particular cases the one, a squamous-cell carcinoma of the cervix, showed great destruction of carcinoma cells with intense congestion and polymorphonuclear and other cell infiltration. The destructive effect was seen throughout the length of the cervical canal and extending about 1½ cm. into the wall, but *beyond this were numerous living carcinoma cells.*

In the other case, which clinically presented continuous small

hemorrhages and aroused the suspicion of carcinoma of the fundus of the uterus, the uterus was soft and boggy, the entire uterine cavity giving evidence of intense inflammatory reaction, the mucosa and considerable muscle tissue immediately about the site of the radium being necrotic and deeply ulcerated. The remainder of the mucosa also showed ulceration extending from a part to a whole of this structure. Beyond the necrotic area here, likewise, there were living carcinoma cells.

My remarks have been made on the basis of 500 hysterectomies performed by me at the Lankenau Hospital since January 1, 1916. These 500 cases comprise carcinoma of the uterus, 27 (no deaths); myoma uteri, 367; diseases of the uterus, tubes and ovaries, 106, among the last being 6 ovarian cysts associated with malignancy. The operative mortality of the entire series was 2 per cent., 10 deaths. The details appear in the table given below.

In conclusion, I would say that there is no gainsaying the fact that for certain well-selected cases, more especially inoperable ones, radiotherapy has a tremendous field of usefulness. If the day is at hand when it can be judiciously and successfully applied to all cases of cancer, none would more eagerly hasten the time than the surgeons themselves. The object of the profession at all times is to mitigate and to rid the world of cancer, one of its most distressing sore spots.

		Number.	Deaths.
Myoma uteri		367	6
Chronic cervicitis		10	
Chronic endometritis		32	3
Salpingo-oöphoritis		18	
Prolapse, uterus		20	
Prolapse, vagina		2	
Vesicovaginal fistula		2	
Ectopic pregnancy, left cornu		1	
Bicornuate uterus with chronic endometritis		1	
Ovarian cyst (malignant, 6)		14	
Acute suppurative endometritis		5	1
Hydatidiform mole		1	
Carcinoma of the uterus		27	
	Cervix 11		
	Fundus 12		
	Chorio-epithelioma 2		
	Carcinomatous polyp 2		
		500	10

MULTIPLE SCLEROSIS AND PSYCHOANALYSIS.*

A PRELIMINARY STATEMENT OF A TENTATIVE RESEARCH.

By Smith Ely Jelliffe, M.D., Ph.D.,
NEW YORK.

My personal interest in what has been subsumed under the term "multiple sclerosis" began in 1900. At that time, working in the Vanderbilt Clinic with A. B. Bonar, some 60 cases were examined in great detail from the sensorimotor point of view, and a monograph on the disease was projected, the first approach toward which was published by one of us in 1904. This short study appeared as an inquiry into the then thought of etiologic factors and analyzed the general features in over 100 observations.[1] The necropsy material was quite limited, however, the patients having been drawn from polyclinic material, and when Müller's[2] excellent monograph appeared in this same year, documented on rich necropsy material, the rather ambitious program that had been drawn up was abandoned as projected.

Since that time, however, my collecting propensities have always maintained a special predilection for this interesting syndrome. I have become more or less sensitized to the problems involved. They have never been far from the focus of my interest and the many perplexities and difficulties have been the subject of much inquiry from clinical sources, the chemical laboratory, pathologic section and therapeutic endeavor.

So far as the pathologic pictures have contributed to the furthering of the little knowledge that we as yet possess, without burdening this short *resume* with too exhaustive an analysis, it has been learned definitely that disseminated foci, which may occur in the cerebrospinal pathways and arise from a variety of causes, may produce clinical pictures which on cross-section have many features that would entitle them to be diagnosed as "multiple sclerosis." These may be termed, for the purpose of this note, the *secondary types*, with the discussions concerning which this Society is fairly familiar. Certain cases of infection from a variety of organisms (influenza, poliomyelitis, lethargic encephalitis) and a special group of disseminated syphilitic encephalomyelitides offer especially interesting polemic material, attention to which has been called by a number of observers, notably Riese,[3] Schültze,[4] Klingman[5] and Spiller.[6]

* Presented before the American Neurological Association, June, 1920.

[1] Jelliffe, S. E.: Multiple Sclerosis: Etiology, Jour. Nerv. and Ment. Dis., July 1, 1904.

[2] Die multiple Sklerose des Gehirns und Rückenmarks, Jena, 1904.

[3] Arch. f. Psychiat., 1919, vol. lx.

[4] Deutsch. Ztschr. f. Nervh., 1920, lxv, 1.

[5] Am. Arch. Neurol. and Psychiat., 1919, i, 39, 193. Ibid., 1919,, i, 219.

The new spirochete of Kühn and Steiner may be included here if finally verified. With these secondary types, mostly of infectious origin, however, we are not now concerned.

More and more it has come to be believed that a special type with a fairly distinctive pathologic foundation is recognizable. Many, perhaps most, of the so-called *primary multiple scleroses* are to be thought of in this connection, but neuropathology is not yet in a position to decide offhand even concerning this point.

The pathologic picture of what I take to be this group has been most exhaustively analyzed by Dawson,[7] Klingman and others, and it is with reference to this hypothetical series of cases that the present series of notes applies.

Here the chief pathological lesion seems to have its inception in a special type of disturbance of the vascular apparatus which is functionally integrated with the work being carried on in the different neural metameres. The minute histology of these changes I shall not discuss here. Klingman, Dawson, Cassirer and others have afforded the details for the conception. I simply wish to call attention to certain affiliations with another type of vascular alteration in which the detail of the histological picture is closely related, if not identical.

Even should it require an extensive polemic to decide concerning the identity of these changes the point at issue is not seriously modified. These changes are those lying behind what has been called the exudative diathesis and of which the studies of Cassirer[8] have given us a broad outline. The catatonic "Hirnschwellung" of Rieger and Reichardt[9] is one of the manifestations of this type of vascular dysfunction upon which special emphasis may be laid as well as to various so-called neurotic arthritides, skin exudates, asthmatic exudates, hay fever, etc. The relationship of these phenomena to the vegetative nervous system control and attendant psychological factors is the concept which is of interest in this research and which has a large and important background. This general background has been elaborated *in extenso* and made the basis of an attempt at a unified attack upon the whole problem of nervous diseases and a general dynamic pathology as well.[10]

Shifting for a moment now to physiological considerations, attention should be called to the generalization of what Sherrington[11]

[7] The Histology of Disseminated Sclerosis, Rev. Neurol. and Psychiat., 1916, xiv, 285; Tr. Royal Soc., Edinburgh, 1916, pt. 3, No. 18, i, 517 (with complete bibliography).

[8] Die vasomotorisch-tropischen Neurosen, ed. 2, Berlin, Karger, 1912.

[9] Ueber "Hirnschwellung," Ztschr. f. d. ges. Neurol. u. Psychiat., 1911, iii, 1.

[10] See introduction to text of Jelliffe and White: Diseases of the Nervous System, 1919, 3d ed. Also see Brown, W. L.: Sympathetic Nervous System in Disease, 1920. Kempf: Autonomic System and Personality; Nervous and Mental Disease Monograph Series, 1919. Noel Paton: Nervous Regulators of Metabolism, 1919. White: Foundations of Psychiatry, Nervous and Mental Disease Monograph Series, No. 32.

[11] Integrative Action of the Nervous System, New York, 1906. Also see Childs: Evolution of the Nervous System, Chicago, 1920.

first termed the "action pattern." I need hardly refer to the automatic integrating work which is constantly going on in response to conscious and unconscious desires, to the complicated series of neural, vascular and biochemic integrations which, under the organization of the vegetative nervous system, are in constant working activity, carrying on the biologic work of satisfying necessary human cravings, the satisfaction of which means the maintenance of the individual and the continuance of the phylum.

It was at this point some five years ago that I determined to learn, if possible, from the study of the unconscious thought processes, whether any information could be obtained whereby one could predicate whether something was amiss with the unconscious action patterns, and if so whether any correlations could be made between such faulty action patterns and the neurovascular integrations that would be called on in the attempt to carry these action patterns out or to control the resultant behavior.

Up to the present, then, the argument briefly stated is that in a certain type of "multiple scleroses" patients, certain vascular reactions occur which permit exudative and proliferative changes of a nature similar to those seen in certain exudative constitutional states known to be intimately related to vegetative nervous system disorders of a special type.

These foci are disseminated and follow no as yet understandable principle of localization. We assume, however, that the locus of distribution is in some way related to an action pattern of some kind. That the neural integrative mechanisms needed to carry out the action pattern is under a chronic state of postural tonus and that the vascular integration mechanisms which are required to supply the neural metamere to carry out the action pattern is under a particular and special form of stress.

The vascular alterations are known to be closely bound up with emotional stimuli. Hence the problem postulated is to ascertain if there are specific emotional stresses going on in the unconscious which may be correlated with the rest of the mechanisms here outlined.

For example, suppose the initial symptoms of a multiple sclerosis were those of a choroiditis with eye-muscle unbalance; then that these were followed some few years later by pyramidal tract symptoms chiefly involving the long flexors of the thigh and the extensors of the leg of the right side, making the movements of getting into an erect posture, going up stairs, kicking, etc., difficult. Now an investigation of the proprioceptive nerve supply of the ocular muscles involved in the unbalance and the postural tonus of these muscles as they pull upon the eyeball is imperative. What relation could a chronic pull from possibly unconscious activities have upon the vegetative control of the metabolic elements of the sclera, the choroid and possibly by extension to the retina? The pathologic

picture here needs investigation. So far as I can find it never has been done. What part does the retina play in this unconscious fixation?

Then as for the muscle groups involved in the pyramidal tract impairments. The character of the defect tends to point to certain localizations in or about the chief integrating pathways to permit certain types of action. What is this action pattern? Are there chronic postural tonicities under constant unconscious emotional stimuli that may impair the metabolism of the reflex vegetative arcs involved in the action patterns? If so, how are such unconscious emotional strivings to be recognized, evaluated and finally correlated with the rest of the situation?[12] Such is a partial statement of the bare outlines of the problem.

The details and the significance of the work of Pavloff, Cannon,[13] Kempf[14] and others working in this newly opened field I shall assume is known to all here present—even the polemic material concerning the validity of the generalizations that definite and predicable changes in the entire physiologic activities as well as morphologic alterations of the cells of the body may be occasioned by emotional reactions, such as hunger, fear, rage, pain, etc., I shall also assume you to be thoroughly acquainted with. I need not go over the arguments. They are obvious.

What the early studies of these investigators proved was that certain correlations proving the general validity of the position here taken are capable of being experimentally repeatable and verifiable in lower animals. The vast literature of psychiatry shows that similar correlations, though more intricate, are true for human beings.

My material is necessarily limited. It has been difficult at times to get the necessary coöperation. Either the patients were not suited for the studies which I hoped to make, because of the mental deterioration so frequently observed in multiple sclerosis, or they lacked the time, or they were not sufficiently intelligent to enter into the investigations in any hopeful sense.

My material in this experimental research is drawn from five patients, only two of whom offered some approach to helpful coöperation. The most fruitful material was obtained from these two patients who could continue psychoanalytic procedure for several months.[15]

[12] Sherrington: Proprioceptive Nerve Supply of Ocular Muscles, Brain, 1918, li, 332. Postural Activity of Muscle and Nerve, Brain, 1915, xxxviii, 191. Kempf, loc. cit.

[13] Fear, Rage, Hunger and Pain and the Nervous System, New York: D. Appleton & Co., 1919.

[14] The Autonomic System and the Personality, Nerv. and Ment. Dis., Monogr. Ser. 28, New York and Washington, 1919. Psychopathology, St. Louis, 1920.

[15] Jelliffe: Technic of Psychoanalysis, Nerv. and Ment. Dis., Monogr. Ser. 26, New York and Washington, 2d ed., 1920.

What developed? In the first place there was an extremely interesting uniformity in the character of the dream material:

1. All of the patients gave me very definite archaic symbolizations.[16] We are scarcely able yet to go far into this nor into the as yet incomplete generalizations as to the significance of this material as bearing on the thwartings of the cravings of the patients and the influence of these thwarting on the neural mechanisms of the action patterns and of the metabolic upkeep.

Yet we must consider to some extent such things as these definite archaic symbols, since they may have a special significance in our measurement of the affective disturbances contributing to the patient's illness. Any therapeutic measure must be based on some notions of exactness. I think it was Plato who was among the earliest to insist on the value of the reduction to measurements in some form of exactness in science. Yet in the realm of psychic difficulties and the impairment of the nervous system that lies so close to this that the two are inseparable, we have been most hampered by inexactness and difficulty of precise measurement and definition. It is needless to say that this does not pertain to the psychic side of the equation alone, for we are still too far away from any complete exactness of measurement on the purely physical side. How many centuries, for example, will have to elapse before scientific accuracy has become so refined or so well extended that all the physical factors which enter, both as cause and effect, into the disease picture at any one time in multiple sclerosis could really and all together be taken into account? While we are examining the renal output have we measured the registration of the disease process which pulmonary respiration might have given or the influence of the pulmonary intake or the facts which might have been discovered through sweat-glands or heart action or muscular postures or any other part of the vast field of bodily registration?

In the science of physics there are already certain well accepted mass units by which general physical facts may be determined and defined. In the activities of the living functioning human body we have only mastered a few. Experiment is multiplying these, but necessarily slowly, and meanwhile these processes, including those of disease, go on in large part unobserved and unmeasured. It is here that we cannot afford to neglect any new system of measurements which may have been discovered and been formulated in the psychologic realm. Not that these can claim a completeness which is present in the physical realm. That would not be possible in a realm, the psychic, which is limitless in comparison even with the multiplicity of the forms of body activities. Neither can it claim any hard and fast precision.

[16] Jelliffe and Brink: The Role of Animals in the Unconscious, Psychoanal. Rev., July, 1917, iv, 253.

Yet from the nature of psychic activity, be it in thought or feeling and their numerous intergradings, there is a unit of measurement which is ready at hand. Thought and feeling have always tended to express themselves in symbols. These I have called energy carriers.[17] They may be conceived of as groupings of the sum of the affects and the mental processes stimulated by this affect, related to any object in the environment and the personal output of energy, corresponding to biologic needs, toward this object. The symbol becomes therefore the picture of the individual comprehension of any object or situation plus his energy activity toward it. Any symbol, therefore, chosen by the mental life, conscious or unconscious, stands as a chosen mass unit which measures the energy involved in any situation for which the symbol is used. May it not also be more than a mere measurement, for it may serve as well to define and locate this energy in the individual's grade of development or the level of his being at which this energy expenditure is made.

The psychotherapist is supposedly equipped with such a knowledge of the history of human development in terms of the individual's relation to his social environment that he can tell what are the forms of activity, of energy output demanded by the society in which the patient happens to live. He is able to define the higher intellectual form of the symbol by which the individual may seek free and effective expenditure of his energy to satisfy his personal requirements. This on the higher levels means the building up and healthy utilization rather than the tearing down of his machine, the body or some portion of it, in our case, as the spinal cord. If then the dreams reveal that in the unconscious, which is the larger portion of his mental life, he is utilizing not a symbol which is thus expanding opportunity and giving freer vent to energy, but one which refers to a long past no longer socially useful, may it not be seen that something is wrong?

At a remote archaic age when thought was simpler, feeling found its action pattern pathways more simply and more readily and the demands of a more complicated social standard did not exist. Now, however, thought, elaborating with the progress of culture, has built up a far more complicated form of demand. In order to keep pace with this, the body has had to learn through the widely extended psychic symbolism, to distribute its energy on many pathways, utilizing again the symbol for such energy expenditure. Now if it is seen through the dream that the symbolism, that is the picture of the individual's interest, confines itself to the simpler, more condensed archaic form may it not be conceived to indicate that the individual has abandoned (regression) or has never attained (fixa-

[17] Jelliffe: The Symbol as an Energy Container, Jour. Nerv. and Ment. Dis., December, 1919, l, 540; Tr. Am. Neurol. Assn., 1919.

tion) the higher levels. He has no lack of feeling, of affect, but its ways of discharge are confined. The energy that it represents cannot find healthy outlet. What more natural then than that there should have resulted from fixation or regression to such a level an infusion of energy into bodily pathways, a refilling of old channels which culture has relieved by the long building up of the wider mental activity?

These old action pattern pathways in the somatic territory have normally their sufficient task. In the well-developed individual the distribution of energy through widening of the symbol, the "soul" or "spiritual" development, has left the proper safe amount of functioning, of energy carriage, on any one of them. If, however, they receive such reanimation and reinfusion from the blocking of the higher pathways it can readily be seen that disaster may result. It is the confined power that destroys instead of running the engine.

Since, then, it is impossible yet to measure or accurately to locate the causes of the vascular exudative phenomena by employing purely physical concepts, it is at least justifiable to examine the psychic symbol with all they reveal of energy blocking, the attempts to use wornout ways of thinking and feeling, the reaching toward environment by clumsy primitive tools instead of through efficient modern methods. In the recognition of such symbols and in their use as measurements we ought to get some more definite and comprehensible idea of the struggle the energy is making and of the ravages it is causing, and why. Experience with the multiple sclerotic patient in psychoanalysis shows that this is a handle whereby the problem can be practically attacked with him and wherein also he in his reëducation can take hold to make a readjustment.[18]

2. Furthermore, in all of the patients there was extremely violent hate material held under the most forced repressions. None of the patients had freed themselves from the most infantile types of fixation on father or mother images. This might have been surmised from the characteristic "hysterical" personality of so many of these patients, using this word in the old sense.

3. For those who have taken the time or trouble to investigate the unconscious and are at all acquainted with the present-day conceptions I might add that very marked sister and brother fixations were present.

4. Sadistic anal erotic complexes were striking. These are intimately correlated with the unconscious hate situations.

5. The unconscious narcissistic homosexual components were found in all cases under extreme repression.

In all of the patients this last had produced the fear of the oppo-

[18] Jelliffe: The Vegetative Nervous System and Dementia Precox, New York Med. Jour., May 26, 1917.

site sex and had made marriage a nightmare or an impossibility—but none of the patients had had the courage to risk social censure and free themselves from what they projected as an intolerable burden. They thus repressed their hatred and made futile unsuccessful compensatory attempts.

I would like to present very briefly one small sample of the material which has given rise to the summary of findings just made. Thus one patient with a marked paraplegia, with foci in the lumbar cord, dreams the following archaic mythological fragment "*of a magnificent specimen, half horse above and half man below. He is struck with the magnificence and power of the lower extremities. This centaur-like being approaches a woman who fears him, but then acquiesces in his intentions, the horse part of the body having become less pronounced. It approaches her from the rear and would have intercourse, but by the vagina. There is no orgasm, but intense excitement.*"

These particular symbolizations which I have mentioned give examples of the intensified and compressed energy repressed to a very low level, which ought to be aroused to action to satisfy organic needs by bringing these into better relation with the environment. That at least is the only healthy action of energy. Here the energy is aroused but seeks to satisfy itself with goals which are no longer part of reality, or in relations which would be no longer of actual service to the individual in his adjustment to environment. They are the substitution therefore of fantasy rather than reality objects and situations. This does not give outlet and must drive the patient into the direction of a psychosis or, as in these cases, animate to excess body channels of an older level of activity. This makes it necessary for them to carry a task which is too heavy for them. Instead of the lighter weight of function, then, which ordinarily belongs to the spinal cord, it is asked to sustain an additional energy drive and breaks down. Enough of this energy, however, still remains in the psychic sphere to create the dream picture just given. The very nature of the picture and the features of the dream show that it cannot become the sufficient carrier of the energy, the pathway for its discharge. It is true that the dream is an aid in itself to the discharge of energy still lingering at lower levels but only to a limited extent. A more helpful dream is one that presents more of the progressive forward tendency and is accompanied in the waking life also by a greater ability to utilize adult, highly cultural levels of activity for energy discharge. Notice at the end of this dream the indication of its purely fantasy, non-effective character: "*There is no orgasm but intense excitement.*"

It can be conceived that there was a time in development when what we now call an archaic level, a more bestial[16] or an animal level formed the highest cultural level of discharge. Let us say for argument that it was merely in that period of human history when man's own form was grosser, his attention to this physical life less

modified, less refined. Such an archaic repetition and choice of animal forms in the dream may represent this more animal nature of man or even a period when perhaps the life of animal and man was more closely associated than now; and when man, at least, like the child of today, felt less distinction in feeling and form and individual satisfaction from the animals about him than he does today. He attributed to the animal more identity of experience and feeling than would be possible for the adult today. The most humanized adult would have to confess today to some trace yet of this amalgamation even in his conscious thought. Clearer traces of the strength of such an amalgamation of conception, of the admission of animals freely to thought and feeling lie in those tales of ancient Greece and Rome which have been embodied so charmingly in Ovid's writings. He wrote in a later critical literary age, when such beliefs were relegated, among the most cultured at least, only to the poet's fancy. But he really spoke of and for an age that had hardly passed away. Early belief had represented a more serious mingling of human and animal experiences, at least in man's fantasy, human desire seeking itself in animal and through animal form. Poetry, especially such poetry of less trammelled Greece, could still take up such desire and open the gates for much of the energy expression which still lingered at such layers. Today, however, energy that tarries at such levels is blocked. Thanks to literary preservation we still have Ovid, and perhaps he should form more often part of the patient's curriculum for reading. He offers as it were a horizon toward which the mind looks out in its efforts to broaden its vision, more to broaden its scope of action.

The body's needs, our organic cravings, are very ancient. The mind is the sum, a constantly increasing one, of feelings and reckonings, thought permutations and communications concerning the needs and the feelings associated with them. *It is the organizer of all phyletic experiences.* This mind or psyche has always been at work casting and recasting symbols which represent shifting paleopsychologic horizons,[19] widening vision, greater power and greater satisfaction through extension of horizons. The ability to look bravely out at each such paleopsychologic horizon and then mentally to cast and recast until that is in turn enlarged into another, represents progress and it represents health and lessening of inner tension through outer expression. Without this, thought and feeling become caught, fossilized in fixed layers, yet with this difference from geologic fossils—that in the mental world the fossils still live. The unreleased energy strains, struggles, and pulls whatever of individual striving and effort may have escaped back to its level or sorely divides the individual so that only partially effective

[19] White, W. A.: The Contribution of Modern Psychiatry to General Medicine, Osler Memorial, New York 1919, p. 1228. Also Foundations of Psychiatry, loc. cit.

activity is possible on higher levels and a large part of the energy tears and destroys at the lower level. Either it is dragging at the personality and forcing it into separateness from the world in the fantasies of a psychosis or it is allowing its destructive activity on some somatic pathway as in these multiple scleroses cases.

Energy means dynamic strength and this must exercise itself in one direction or another. Thus the necessity to open the horizon and then extend it again and yet again, which is the unending task of culture in the service of perfect health, or perfect health in the service of culture. For this there is no other tool than the symbol. This has been spoken of as an instrument for measurement, a mass unit. It is also a tool for forging ahead and maintaining the health of the whole personality, body and mind. By it the mind for itself and for the body gathers up the energy, lifts it out of its discarded level of an earlier passing or long passed culture, sketches the breadth and meaning of the new level and drives ahead into this.

Just how these compensatory efforts are prevented from getting out as compulsion neuroses[20] or a chronic neurosis of some type would make an interesting field for speculation; or looking at the situation from the point of view of making the body the scapegoat of the spirit, why do not these patients dissociate their conflict—develop a psychosis even if mild—and save the bodily structures. The catatonic makes an effort in this latter direction, but even then fails.[21] Mysticism and religion are more successful.

Claude Bernard[22] tells us that he hopes "some day the time will come when the physiologist, the philosopher and the poet will talk the same language and understand each other." I have often wondered if Hawthorne in the *Scarlet Letter* had not offered a striking illustration of the partial fulfilment of this wish of the great French physiologist when he wrote: "A bodily disease which we often think of as a thing apart and separate may, after all, be but a symptom of an illness in the spiritual part of our nature."

[20] Jelliffe and Zenia X.: Psychoanalysis and Compulsion Neurosis, Psychoanal. Rev., April, 1920, vii, 134; Compulsion Neurosis and Primitive Culture, Psychoanal. Rev., 1914, i, 361.

[21] Kempf: Mechanistic Classification of Neuroses and Psychoses Produced by Distortion of Autonomic Affective Functions, Jour. Nerv. and Ment. Dis., August, 1919, l, 105.

[22] See Preface to Kraus, Fr.: Die allgemeine und spezielle Pathologie der Person, Klinische Syzygiologie, Thieme, Leipzig, 1919.

THE SURGICAL TREATMENT OF EMPYEMA BY A CLOSED METHOD.[1]

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The surgical treatment of empyema has always been very unsatisfactory. The unusual prevalence of empyema during the World War made it one of the most discussed surgical subjects of this period and called forth numerous methods in attempts to lower the prevailing high mortality, which was 30.2 per cent. in the various army camps during the winter of 1917–1918. The so-called open operation which dates from the time of Hippocrates, with or without rib resection, was the method most generally used and will long continue to be used regardless of comparative results, because of familiarity and the inertia of custom.

For eighteen months the writer had charge of the empyema wards at Walter Reed General Hospital, Washington, D. C. and the Base Hospital, Camp Pike, Arkansas, and developed what may be termed a closed method. Immerman, in 1887,[2] described a method somewhat like the one about to be described, in that he inserted a single tube into the pleural cavity, air-tight and maintained negative pressure, but did not use a syringe to remove the fluid nor was any fluid injected. Since this time many methods, with some form of modification of the method described by Immerman, have been tried, with varied success.

This article is based on a series of 138 cases, 45 acute and 93 chronic, treated by the writer, with a mortality of less than 2 per cent., which is thought to be the lowest rate reported by any method in so large a series. Reports have been received from 80 per cent. of the cases, and no case, acute or chronic, is known to have recurred. It is believed the results attained by this method are sufficiently striking to warrant its being submitted as the simplest, the most efficient and the most practical of all methods for the treatment of acute empyema.

This method is clearly demonstrated in two reels of films, which are available gratis, for use by any medical school or medical society, by addressing the Curator of the Army Medical Museum, Washington, D. C.

[1] Read at the thirtieth annual meeting of the Western Surgical Association, Los Angeles, Calif., December 3, 1920. Read before the Illinois Section of the Clinical Congress of the American College of Surgeon at Peoria, December 17, 1920. Also read before the County Medical Society at Indianapolis, Denver, Salt Lake City, Ogden, Reno, San Francisco, Long Beach, Phœnix, Tucson, Kansas City, St. Louis and Louisville.

[2] See editorial note, Jour. Am. Med. Assn., February 1, 1919, p. 267.

Details of Closed Method in Acute Cases. Inasmuch as the success or failure depends upon many minute details, seemingly of minor importance, more space is given to the exact technic.

The place of election for operation is the eighth interspace in the postaxillary line. A diagnostic puncture at this point having revealed fluid containing microörganisms, the operation is performed at once regardless of the condition of the patient or stage of pneumonia. Care must be taken to prevent wounding the lung. To avoid this accident the needle puncture is made just before and always at point of puncture with a straight trocar, which should not have a long point. The cannula should be just large enough to admit snugly a standard Carrel tube.

The writer has found more than 2 c.c. of 0.5 per cent. procain unnecessary and has performed the operation 15 times without any anesthetic and with little pain to the patient.

At the site of operation a stab not more than 5 mm. in length, through the skin only is made with a curved bistoury. The cannula is smeared with vaselin to prevent the edges of the tiny wound from clamping it. The patient should have the arm and shoulder raised, take a deep breath and hold it, thus separating the ribs as the trocar is inserted. The needle puncture, skin stab and insertion of the trocar can all be done in less than a minute.

The tube should be about fifteen inches long, seamless, and have from five to ten fenestræ, about 3 mm. in diameter and 1 cm. apart, within the cavity to facilitate the removal of fluid when fibrin clots are present. When the trocar is removed, instantly the tube is inserted through the cannula, which is now removed, leaving about six inches of the tube outside the chest.

The tube is held air-tight by the contracting wall of the wound and may be connected with a Potain aspirator, or the fluid may be removed by a half ounce bulb syringe,[3] which is used in giving the treatments. Should the respiration become embarrassed from too rapid removal of the fluid it is advisable to stop a moment or inject 200 to 400 c.c. of Dakin's solution before continuing the removal. If the patient has a high temperature, with active pneumonia, normal saline is used instead of Dakin's solution, to cleanse the cavity. This is done by refilling the cavity nearly one-third and agitating the fluid in the cavity by quick compressions and expansions of the bulb.

The small dressing permits free chest expansion. A No. 00 safety pin is thrust through the edge of the tube. Two thin pads of gauze, each one inch square, split to the center, are placed over and under the pin. A pad two inches square of twelve layers of bandage gauze, with a hole in the center, made by a pointed and rounded instrument, and never cut, so as to admit the tube snugly, is then

[3] The syringe and trocar used in this work are made by Becton, Dickinson & Co., Rutherford, N. J.

applied. Four strips of adhesive, each one and a half inches wide and three and three-eighths inches long, are applied so as to make the finished dressing square. This dressing will frequently last several days, as there is seldom any soiling around the tube unless the incision was made too large, or the patient have a very persistent cough, which should be controlled if possible. Should the dressing become soiled a razor blade is best to cut the dressing from the tube. Usually it will suffice to loosen one side of the dressing, change the two small pads and apply a new strip of adhesive. The patient can lie in any position without discomfort or danger of the clamps or tube becoming loose.

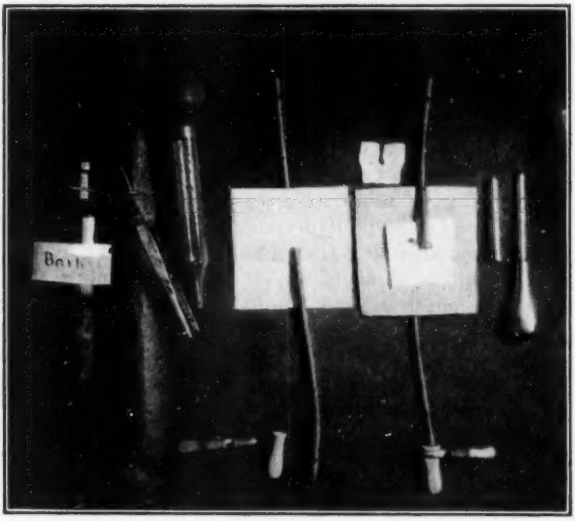

FIG. 1.—Shows individual tissue forceps, syringe and bottle for solution. The top and bottom of a typical dressing is shown, also trocar cannula.

Each patient should have his individual tissue forceps, syringe and Dakin's solution in a wide-mouth bottle where the syringe is kept between treatments. The forceps facilitates handling the tube in preventing air from entering during treatment and makes the wearing of gloves unnecessary. The end of the tube is kept sterile by being capped with the rubber from a medicine dropper held on by a Daeffenbaugh clamp or spring clamp or clamp or bulldog clamp, which maintains the negative pressure.

In giving the treatment it is best that no air enter. The tube is first compressed with the tissue forceps, the clamp and cap removed, the nozzle of the syringe inserted with the bulb compressed and the secretions aspirated. From 50 to 200 c.c., depending on the size

of the cavity, of Dakin's solution are now injected and agitated. This is removed and the process repeated until the return is clear. An amount equal to about one-fifth the original capacity is now injected and left in from five to thirty minutes, then removed and the maximum negative pressure reëstablished. The treatments usually are given every three to five hours by day and once or twice at night until the pyogenic membrane and fibrous exudate have been dissolved, a process taking from two to fourteen days, depending on the kind of infection, duration of case, size of cavity and the general condition of the patient. Subacute cases will tolerate more vigorous treatment, while cases with active pneumonia should be irrigated only every four to eight hours until the symptoms subside.

Glass piston syringes should not be used; unlike the bulb syringe, they are expensive, break easily, troublesome to sterilize and difficult to handle.

The suction power of the bulb syringe will lift water to a height of eight feet in a 6 mm. tube. That it will prevent pneumothorax is clearly shown by a radiogram taken just before and after negative pressure is established. Very little suction is required to expand the lung, and frequently the patient cannot endure the pain caused by the maximum negative pressure of the bulb.

When the tube is purposely opened, air immediately enters as the lung collapses to a certain degree, which depends largely on the adhesions and size of the cavity. If air so admitted is aspirated, the number of bulbs of air removed counted and the whole process repeated the number of bulbs of air removed will invariably be the same; furthermore, if after a maximum negative pressure is attained and any known number, say 5, 15, 30 bulbs of air are injected into the cavity and the process reversed, the number of bulbs of air aspirated will always correspond with the number injected. The same is true if a liquid is used instead of air, thus proving conclusively that the empyemic cavity can be entirely emptied of either air or fluid. The same is true regardless of the position of the patient or whether the tube is inserted at the most dependent part of the cavity.

That negative pressure is maintained for several hours is shown by the sound of air rushing into the cavity when the tube is left open, and the patient feeling a change of pressure or if the tube is connected to another tube leading into a bottle containing Dakin's solution the solution will be drawn into and fill the cavity.

When a large empyemic cavity is thoroughly cleansed and 150 c.c. of Dakin's solution injected and kept agitated a specimen withdrawn at the end of one minute will usually test about 0.38 per cent., and after five minutes will usually test about 70.0 per cent.

It is not essential that the sodium hypochlorite solution be 0.47 per cent., as 0.6 per cent. can be used for a reasonable time with

safety in the pleural cavity. With such a wide margin it is a simple matter for those who do not have the usual facilities for making and testing Dakin's solution to make up a solution sufficiently accurate from the various commercial products. Hychlorite is used now and found to be both convenient and effective.

After the amount of secretion and sediment have been greatly reduced, usually in four to ten days, and smears and cultures negative or nearly so, instead of continuing the treatment as before one should change to and inject a twenty-four-hour-old solution of 2 per cent. dilution of liquor formaldehyde in glycerin once daily for the following reasons:

1. Complete sterilization is attained in from three to seven days and the tube can be removed before the cavity is completely obliterated.

2. There is less discomfort to the patient and his sleep not disturbed.

3. The cavity is made to develop a tolerance for an antiseptic, which antiseptic is advisable to leave in the cavity, when the tube is removed, to prevent recurrence.

4. The resultant secretion following the injection of the formaldehyde solution forms unfavorable media for bacterial growth, and when sterile will be readily absorbed and the cavity obliterated.

The first two or three injections, which should not be over 5 c.c., will usually cause a rise of temperature, and for this reason should not be used too early in acute cases. The amount may be increased up to 15 c.c., but larger amounts are not necessary. Before each injection the cavity is given the usual treatment with Dakin's solution. If there is much sediment present the regular two-hour treatments with Dakin's solution should be given during the day and the formaldehyde solution treatment given once for the night.

It has been observed that both smears and cultures sometimes will remain positive for organisms for several days after beginning this treatment, even when the secretion gives a positive test for formaldehyde. There will be, however, a gradual decrease in the number of bacteria in both smears and cultures, and sometimes the latter becoming negative first.

Removal of the Tube. The original tube is not removed until the case is completed. Just before the tube is removed the cavity is given a thorough treatment with Dakin's solution and from 5 to 10 c.c. of formaldehyde solution is injected and left in the cavity. The dressing should first be removed and the skin cleansed with ether. An iodin swab is inserted in the sinus and rolled around the tube. The finger, one inch from the sinus, will compress the sides of the sinus during and after the tube is quickly removed, to prevent air from entering. The sinus is again treated with an iodin swab, the field cleansed with alcohol and the sinus closed with three wide strips of adhesive six inches long. Sometimes it is well first to make

two folds of skin over the sinus or apply a tiny alcohol pad. The second or third day it is well sometimes to remove the adhesive, treat the sinus and apply a similar dressing.

The amount of fluid secreted into the cavity after the tube is removed varies with the size of the cavity at this time, the number of treatments with the formaldehyde solution and the amount left in the cavity when the tube is removed. This, however, is a matter usually of small importance. If this fluid is sterile it will be absorbed sooner or later, or if necessary it can be aspirated, as in the ordinary sterile pleural effusion and the cavity gradually obliterated. If the fluid reaccumulates and contains organisms the general condition, failure to gain weight, physical signs and leukocytosis will be indication within a few days for the reinsertion of the tube, which was done in 5 cases, from whom the tubes were removed, very early as an experiment before sterilization.

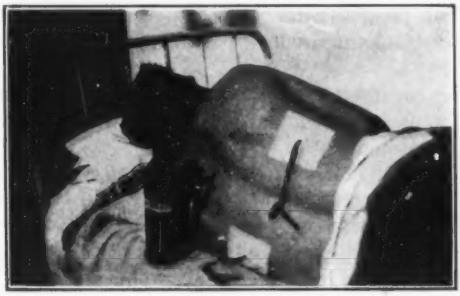

FIG. 2.—Bilateral empyema under treatment. Tube on right side removed in thirty days, tube on left side removed in twenty days. Operated when patient had bilateral pneumonia.

Importance of Diagnosis. The diagnosis of empyema is often difficult. There can be no doubt that many pneumonia cases die complicated with empyema undiagnosed. A large percentage of such cases diagnosed and properly treated could be saved. The diagnostic puncture or consultation in every serious pneumonia case would often prevent this grave error. The presence of the army doctor at the autopsy table during the World War did much to quicken his interest in empyema. It is believed that if a law were passed making it compulsory for every pneumonia death to be autopsied by a county health officer, or any other qualified person, in the presence of the attending physician and all other physicians interested, undiagnosed empyema cases would be less frequent and eventually fewer deaths.

Who, even of the laity, has not seen or heard of a pneumonia case after having passed the crisis, sooner or later, suffer a relapse and either die suddenly or linger along for weeks or months, and possibly

years, then go to the grave with the death certificate signed "unresolved pneumonia" or "tuberculosis?"

Murphy was called in consultation once to see a patient which the attending physician said had had pneumonia for six months, but proved to be a chronic empyema.

Osler says: "In pneumonia the practitioner should be on the alert if the crisis is delayed or the temperature rises after the crisis, if chills and sweats follow, or if the cough changes to one of paroxysmal type of great intensity."

While the early diagnosis of fluid in the chest is important it is of even more importance to remove the fluid early and keep the cavity empty with the least disturbance to the patient. The effusion sometimes begins soon after the onset of the pneumonia and large quantities of fluid can collect within a few hours. Here we wish to state, with emphasis, that operation, at any stage of the disease regardless of pneumonia, by this method can always be done without the least danger of shock or collapse of the lung, and that those operated earliest after onset give the quickest and best results.

While the roentgenographic and bacteriologic laboratories are always to be preferred they are not absolutely essential with this method of treatment.

Exercise. No uncomplicated empyema case should be kept in bed. From the day of operation, graded, regular systematic breathing and calisthenic exercises are the quickest way to cause expansion of the lung and chest mobility. Unfortunately the novelty of the Woulfe bottles wears away too soon. Naunyn's plan was found efficacious: The patient sits in a chair compressing the well side against the arm of the chair, and taking long, deep breaths which force the expansion of the compressed lung. Only for the first few days after the tube has been removed should he refrain from exercise.

Food. The appetite is the natural guide for the kind of food. Abundant food is an all-important factor in treatment. The comfort of the patient and his ability to take exercise greatly aids the usually ravenous appetite. Many of the cases gained a pound a day for several consecutive days.

Empyema at Walter Reed Hospital. Twenty-three acute cases were operated upon at the Walter Reed Hospital. Eleven of these were reported by the writer[2] and 12 operated upon during the influenza epidemic. Of the latter group 9 cases were operated upon when the patient was either nearly moribund or had an active pneumonia.

Reports since September 1, 1919, from 7 of these cases show good condition. Four cases, 3 recently operated upon, had complications

[2] Jour. Am. Med. Assn., December 21, 1918.

and were still under treatment when the writer was transferred to another hospital. These 4 cases, before closed treatment method was completed, all had a secondary operation, with rib resection, followed by long, convalescent periods.

One of these 4 cases was very remarkable in that 7240 c.c. of thick pus were removed from the left pleural cavity at operation. A careful search of the literature reveals no record of a greater amount of pus ever having been removed at one time from one pleural cavity. The direct smear showed 60 bacteria per field and culture was pure Streptococcus hemolyticus. Negative pressure was impossible because of a bronchial fistula. Radiogram just before operation showed a dense shadow except the right upper chest and immediately after operation showed the left lung completely collapsed, which accounts largely for the complete absence of shock, although two hours were consumed in removing the pus. The fistula closed on the third day and the radiogram showed expansion of the lung, but the patient could not endure the pain caused by the maximum negative pressure. During the six weeks the patient was under closed method treatment; he gained twenty-five pounds, was still twenty pounds underweight and gradually improving. The patient was then subjected to rib resection and treated by the open method with Dakin's solution. Four months later he deserted, with his sinus still discharging.

One case of this group is the only acute empyema case the writer has had the misfortune to lose. This patient had been ill six weeks following influenza and pneumonia. He was nearly moribund, delirious, extremely emaciated, had positive blood culture, pericarditis, multiple abscesses and general arthritis, when a right trocar thoracotomy, in bed, yielded 1500 c.c. pus. The next day a left trocar thoracotomy yielded 2000 c.c. of pus. Radiogram now showed the chest clear and no pneumothorax. Before death, three weeks later, the blood culture was still positive.

Empyema at Camp Pike. The 92 cases treated at Base Hospital, Camp Pike, Arkansas, may be divided as follows:

Group I. Forty-nine acute cases operated by the Diederich method before January 9, 1919.

Group II. Twenty-two acute cases operated by the writer's method after January 9, 1919.

Group III. Twenty-one chronic cases admitted from other hospitals, having had open operations on an average of four and a half months previous.

Group I.

For some months Lieut. Diederich[4] had been using a somewhat similar method, to be described later, but with many essential

[4] Surg., Gynec. and Obst., April, 1919.

differences. Up to January 9, 1919, there had been 107 cases treated by the Diederich method at Camp Pike. At this time there were 74 cases remaining in the hospital, 25 convalescent and 49 still under treatment. Five of the 49 had been operated before October, 16 in October, 17 in November and 7 two weeks prior to January 9.

These latter 7 cases were closed on an average of twenty-six days after operation by more vigorous treatment with Dakin's solution and in addition the use of formaldehyde solution while the 25 convalescent cases had averaged fifty-one days with Dakin's solution alone. Most of the convalescent were in excellent condition. Two had a recurrence and were retubed for three and seven days respectively with no recurrence.

Of the 49 cases only a few had been operated before the pneumonia had fully subsided. An average of fifteen days had passed since the diagnoses of empyema and an average of five aspirations had been done before operation.

Thirty-six of the 49 cases were closed permanently on an average of eight days with the combined Dakin's and formaldehyde treatment. The cavities varied from 30 c.c. to 600 c.c. Roentgen-ray reports on many showed a pneumothorax. The remaining 13 cases had complications and required longer time. Three were bilateral empyemata, 9 had a bronchial fistula and 7 had necrosed ribs, due, it is thought, to injury to the periosteum at the time of operation and required resection.

Treatment of Chronic Cases Secondary to and Following Open Operations. While this treatment is not to be recommended the closed method may be instituted after open operation in acute cases which have been subjected to rib resection or intercostal thoracotomy and have failed of cure. Necessarily these chronic cases are usually more difficult to handle than acute cases originally treated by the closed method.

The sinus may be nearly closed and have to be dilated with a curved hemostat to facilitate the introduction of the small tube. Large sinuses require larger tubes so as to fit fairly snug and make possible negative pressure. In a few days the sinus will usually close sufficiently that the large tube may be replaced by a smaller tube.

The treatments are much the same but may be more vigorous than in acute cases. If the sinus is narrow and deep or the cavity so small that negative pressure is no factor, the tube should be inserted, almost full length of the sinus and at least twice daily the cavity filled to overflowing with Dakin's solution. Following each treatment in the smaller cavities enough formaldehyde solution should be injected to cause the resultant secretion to overflow around the tube. Sometimes it is best to give hourly treatments during the day and the formaldehyde solution but once during the night.

TABLE OF CASES, GROUP II.

No. of case. Name.	Onset of pneumonia.	Aspiration. Date.	Aspiration. Amount in c.c.	Operation. Date.	Operation. Amount in c.c.	Side.	Character of fluid.	Organism.	Days tube was in cavity.	Disposition.
Case 1, W. McG.	Oct. 5	1.9.20	5	1.10.20	330	L.	Thick pus	Pneumococcus	16	Duty, Feb. 11.
Case 2, W. H.	Nov. 16	11.29.20 12.3.20 12.11.20 2.5.20	400 100 10 100	2.6.20	500	L.	Thick pus	H. S.	8	Duty, Mar. 27.
Case 3, R. B.	Oct. 26	3.7.20	10	3.8.20	325	L.	Thick pus	H. S.	7	Duty, Mar. 28.
Case 4, McK. R.	Dec. 23	1.17.20	800	2.1.20	1200	R.	Thick pus	Non-H. S.	36	Duty, Mar. 28.
Case 5, G. N.	Feb. 19	2.23.20 2.24.20 2.25.20	550 900 850	3.5.20	1800	R.	Serous	H. S.	14	Duty, Apr. 15.
Case 6, E. K.	Dec. 28	....	....	3.5.20	320	R.	Thick pus	H. S.	7	Duty, Mar. 31.
Case 7, L. O.	Jan. 17	1.20.20 1.21.20 1.22.20	1500 400 350	1.24.20	750	L.	Thin serous	H. S.	42	Duty, Mar. 20.
Case 8, A. P.	Jan. 13	....	....	2.1.20	540	L.	Thin pus	H. S.	12	Duty, Mar. 24.
Case 9, L. H.	Jan. 9	1.16.20 1.23.20	1500 700	1.31.20	1050	L.	Thin pus	H. S.	21	Duty, Mar. 20.
Case 10, B. C.	Dec. 10	12.16.20 1.3.20	680 75	2.3.20	750	R.	Thick pus	H. S. Staphylococcus	12	Duty, Mar. 24.
Case 11, A. G.	Dec. 4	12.20.20	25	2.4.20	450	R.	Thick pus	H. S.	4	Duty, Mar. 27.
Case 12, H. W.	Jan. 4	1.8.20	30	1.14.20	2250	L.	Thinflaky	H. S.	29	Duty, Mar. 1.
Case 13, L. D.	Dec. 13	12.25.20 7 asp. Apr. 1.	to 1.29 5400 Dry	1.30.20 2.15.20	600 750	L. L.	Thin pus Thin pus	H. S. H. S.	9 19	Duty, Apr. 4.
Case 14, G. T.	Jan. 12	1.16.20 1.19.20	650 1040	1.30.20	2100	R.	Thick pus	H. S.	45	Duty, Apr. 7.
Case 15, H. W.	Dec. 18	1.3.20 2.2.20	100 50	2.3.20 2.21.20	300 100	R. R.	Pus; thin pus	Pneumococcus	10 23	Duty, Mar. 30.
Case 16, J. H.	...	....	....	6.4.20 6.8.20	800 300	R. R.	Pus Pus	H. S. H. S.	4 8	June 16, transferred to General Hospital, No. 12.
Case 17, A. S.	Apr. 2	4.15.20	10	4.16.20	1200	R.	Thick pus	H. S.	42	Duty, July 23.
Case 18, P. McL.	Feb. 24	3.2.20 3.3.20	550 1050	3.4.20	500	L.	Serous	H. S.	48	Duty, June 6.
Case 19, R. D.	Jan. 14 mumps	1.19.20 1.21.20 1.23.20 1.28.20	1475 1450 800 1800	1.31.20	1800	L.	Thin pus	H. S.	45	Duty, Apr. 15.

THREE BILATERAL CASES, GROUP II.

Case 20, R. H.	Oct. 3	10.24 to 11.7.20 4 asp.	2450	....	....	L.	Thin pus	Pneumococcus		
		2 asp.	400	....	....	R^1	Heavy pus	Pneumococcus		
	...	....	....	11.10.20	950	R.	Heavy pus	....	60	
	...	11.28.20	1125	....	....	L.	Heavy pus			
				11.28.20	930	R^2	Heavy pus	....	32	
				12.1.20	200	R^3	Heavy pus	....	49	
		12.4.20	440	....	....	L.				
				12.1.20	200	R^3	Heavy pus	....	49	
		12.4.20 11.30 to 1.1.20	440	....	....	L.				
		10 asp.	2800	....	....	L^1	Pus			
				1.31.20	300	L.	Pus	Pneumococcus	14	Duty, Mar. 3.
Case 21, H. T.	Oct. 1	10.9 to 10.14.20 4 asp.	1550	....	....	R.	....	....	..	Weight normal.
	...	10.21 to 1.9.20		....	....	...	Serous			Transferred to
		15 asp.	3900	10.16.20	200	R.	Serous	H. S.	40	General Hospital No. 12,
				....	....	L.	Pus	H. S.		June 16, bron-
Case 22, R.B.	Feb. 24	3.2.20 3.3.20	450 1050	2.1.20	700	L. R.	Pus Thin pus	H. S. H. S.		chial fistula. Small cavity.
						R.	Thin pus			
				3.4.20	550	R.	Thin pus		30	
	...	3.10.20	10	....	....	L.	Serous	H. S.		
				3.11.20	560	L.	Serous	H. S.	20	Duty, May 20.

No case should be subjected to a Schede, Eastlander or Delorme operation under six months nor before strong negative pressure has been persistently applied for a reasonable time.

A secondary open operation is indicated under the following conditions; ribs necrosed from pressure or injury, a persistent bronchial fistula, multilocular or small irregular cavities and when the lung is held down by thickened pleuræ. After the secondary operation the wound should be closed, with a single tube leading air tight into the cavity, which is then treated as if originally a closed method case.

After a reasonable time though the cavity is not completely obliterated, if sterile, the proper amount of formaldehyde solution

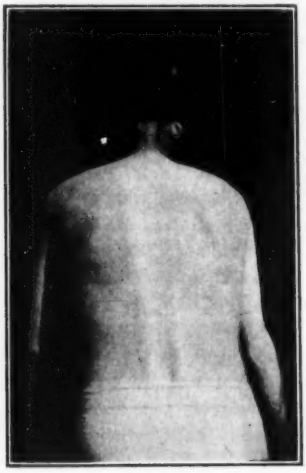

FIG. 3.—Bilateral case five weeks after operation. Returned to duty four weeks later fully recovered. Shows size of scars.

should be injected and the tube removed. The unobliterated cavity will become filled with fluid, which sooner or later will usually be absorbed and the cavity gradually obliterated. At times it is advisable to aspirate two or three times generally following up with injection of small amount of formaldehyde solution, as was first used by Murphy.

Report of Chronic Cases. The following case is typical of the possibilities of this method. Pvt. J. M., August 31, in France, had sixth rib resected for empyema following pneumonia. Admitted November 17, 1918 to W. R. G. H. Condition fair, white blood cells, 12,000. Hemoglobin, 75 per cent. Poor right chest expansion. Copious purulent discharge from small sinus upper right anterior chest. Patient said there had been no change in his condition for

the last six weeks. A small tube was now inserted through the sinus and 660 c.c. thick residual pus removed. Smear showed 55 bacteria per field. Culture staphylococcus. Radiogram showed large pneumothorax. This cavity was treated with 200 c.c. Dakin's solution every hour by day and every two hours by night for forty-eight hours. The maximum negative pressure for the first day caused much pain, due to the lung expanding. During the next forty-eight hours only four treatments were given in which 300 c.c. of Dakin's solution were injected and left in for thirty minutes, then replaced by 15 c.c. of formaldehyde solution. Following the fourth treatment 10 c.c. of the latter were left in the cavity when the tube and original dressing were removed. The sinus was healed permanently two days later. The secretion aspirated twelve hours after second and third treatments was a clear, serosanguineous fluid and the smears

FIG. 4.—Bilateral empyema six weeks after operation. Note full chest expansion.

and cultures of both were negative. December 16, patient had gained fifteen pounds; weight now normal; no pain; 150 c.c. yellowish serum were aspirated. Smear and culture both negative. Had no other aspirations or treatment. Chest expansion nearly full. February 2, returned from thirty days' furlough in excellent condition. Empyema cured.

The 21 cases of Group III, each had a discharging sinus and cavities from 20 c.c. to 750 c.c. The closed method of treatment was instituted and tubes removed in 12 cases on an average of twenty-eight days. No report from two but the other 10 cases show good condition with no recurrence to August 1, 1919.

Report of a Case of Group III. Name, H. R., November 1, 1917. Empyema. Rib resection. Healed September, 1918. Had been on a furlough two weeks when sinus opened. Two weeks later, February 1, 1919, was admitted to Base Hospital, Camp Pike, with

profuse discharge from a small sinus. A small tube was inserted through the old sinus and 750 c.c. of residual pus removed. Culture staphylococcus and streptococcus non-hemolyticus. March 3, tube was removed and sinus closed permanently in three days. March 24, returned to duty with full chest expansion and a gain of 26 pounds. September 2, reports excellent condition with no symptom of recurrence.

Transfer of Cases. On June 16, 1919, when the empyema ward at Camp Pike was closed, the remaining 21 empyema cases were transferred to General Hospital No. 12, Biltmore, N. C. Thirteen of these cases had been operated overseas by the open method. Three were admitted just before transfer and the others had been under closed method treatment too short a time to effect a cure. Of the 8 remaining cases 1 had been operated by the Phillips method, 4, Diederich's, and 3, the writer's method. Of the 4 cases belonging to Group I, all had complications and had been operated in October. Three cases, Nos. 16, 17 and 21 belonged to Group II. Case 16 had a bronchial fistula. Tube was removed June 10, and sinus healed permanently in a few days. Case 17 had gained ten pounds during the twelve days since operation. The tube was removed on the fourth day as an experiment, but had to be reinserted in two days. Case 21 was a bilateral case, with a persistent bronchial fistula, and required secondary operation.

The above 7 cases plus 2 more previously transferred and operated at Base Hospital, Fort Sam Houston, Texas, represent the residue of 129 acute empyema cases having had a trocar thoracotomy at Camp Pike. Most of the cases were of virulent Streptococcus hemolyticus infection and the mortality was only 9 cases, or 6.9 per cent. The mortality here had been 40 per cent. and at Walter Reed Hospital 32 per cent. with the open method as used at the War Demonstration Hospital, Rockefeller Institute, New York. Seven of the 9 fatal cases died during the influenza epidemic and all had complications, 4 of which were bilateral. Had these 9 cases been uncomplicated or even under normal circumstances, with plenty of help and room, they, too, in all probability would have lived. This is believed to be the lowest death-rate ever reported in so large a series of acute empyema.

Of these 9 transfer cases, only 6 of which having a secondary operation, after transfer to another hospital, compare most favorably to similar cases in other base hospitals of large camps, one of which, Camp Lee, Va.,[5] when the empyema wards were closed in June, 1918, following the work of the Empyema Commission, had 140 cases transferred to General Hospital No. 12, Biltmore, N. C. These 140 cases had been treated by the open method with Dakin's solution, and more than half of them after transfer were subjected to major secondary operations.

[5] Surg., Gynec. and Obst., April, 1919.

SUMMARY OF THE 45 ACUTE CASES TREATED BY THE CLOSED METHOD.

Number of cases having a bronchial fistula	8
Number of cases requiring a secondary operation	1
Number of cases having a secondary operation before closed method treatment was completed	5
Number of bilateral cases	4
Shortest number of days tube was in cavity	4
Average number of days tube was in cavity[6]	25.2
Number of cases which had tubes less than fourteen days	18
Number of recurrences	00
Largest amount of pus removed at operation	7240 c.c.
Average number of days patient was in bed after operation	7
Number of cases having but one dressing	8
Number of cases having not more than three dressings	20
Number of deaths (bilateral case)	1

Others Using the Closed Method. Capt. Manson, Chief of Surgical Service, Base Hospital, Camp Dodge, Iowa,[7] reported 23 cases by the closed method, with a mortality of 8 per cent. In the conclusion of his article he states: "Our experience, we believe, justifies the opinion that the closed method thus described distinctly shortens the course of empyema, since it maintains constant negative pressure in the pleural cavity, prevents the collapse of the lung, promotes early adhesions between the lung and pleural cavity and prevents the secondary infections which are so common after thoracotomies. The simplicity of the technic, the minor character of the operation, the cleanliness and comfort of the patient and the economy of time and of dressing further recommend it as the ideal treatment of empyema so far devised."

Dr. Arthur W. Ralls reported in a paper before the Alabama State Medical Association Meeting, April, 1919, a series of 42 cases of acute empyema without a death by the closed method, during November and December, 1918, in the U. S. General Hospital No. 14, at Fort Oglethorpe, Ga.

He gives as factors favoring this method of treatment:

(*a*) This drainage is easily accomplished with the aid of local anesthesia only.

(*b*) Coughing is reduced to a minimum, whereas in costectomy the cough is painful and excessive for a few days.

(*c*) There is positively no shock, while the shock in rib resection is due to a collapsed lung and to disturbance of the natural pressure on the healthy side caused by the mobile mediastinum.

(*d*) There is not the added danger of secondary infection as in a large chest wound exposed often for dressings.

(*e*) The patient is more comfortable and cleanly and there is total absence of odor in the wards.

[6] Average for 18 cases at Camp Pike was 20.2 days. This does not include the 4 cases which had severe complications and averaged fifty-six days.

[7] Am. Jour. Med. Sc., August, 1919.

(*f*) It is possible to drain both cavities simultaneously if desired.

(*g*) By virtue of this method of drainage and the proper use of the blow-bottle and other lung exercise during convalescence, decortication of the lung will be rarely or never necessary.

(*h*) Dakin's gives better results when confined in the cavity for ten to fifteen minutes. This cannot be done under the open method.

Dr. Charles S. White reported before the District of Columbia Medical Society, 12 cases with one death. The fatal case was that of a man, aged forty-five years, who had been delirious three days and moribund when 1500 c.c. of pus were removed at operation. This case followed a streptococcus laryngitis without pneumonia. Nine cases were operated in four different hospitals and 3 in the home. All but 1 case were cured in less than five weeks.

Dr. William C. Borden, Dean, George Washington University Medical School, reports 5 cases with no deaths. One was a bilateral case, both sides operated on at the same time, which he believes to be the first in the District of Columbia to recover, and he thinks the man undoubtedly would have died under any other treatment.

Dr. Anderson Watkins, Little Rock, Ark., reports 6 cases by this method, with complete recovery in from two to eight weeks, and considers the method superior to any method, new or old.

Not all have had as good results as these surgeons. Major Dodge, Camp Sherman, Ohio,[8] reports 3 cases, all failures, by this method. He states they were operated on nine days after the onset of pneumonia; all were very sick and had large accumulations of seropurulent fluid which contained hemolytic streptococci. All seemingly went well and the tubes were removed the third week. Much disappointment soon followed when "roentgenograms showed that the collapsed lungs were not expanding to fill the space." It is evident that due care was not exercised to prevent collapse of the lung. Furthermore, had proper negative pressure been established and maintained in cases operated so early, adhesions would have formed, making impossible the "larger cavities," which Major Dodge states he later encountered. It is significant, however, that all three patients lived, even though secondary operations were performed, as compared to Major Dodge's mortality rate of 26 per cent. in 68 cases by the open method. He not only condemns the use of Dakin's solution in the pleural cavity, but would hasten back to the "pre-war methods," and as he so sarcastically says, "relegate to the boneyard all of the many fancy treatments of empyema evolved by the faddist who has been privileged to observe a series of cases for a limited period of time."

The main trouble usually is that the exact closed method technic is not followed carefully or some modification is used, and on failure the whole method is condemned. It is now and long has been the

[8] Jour. Am. Med. Assn., June 21, 1919.

universal opinion that those loudest in their condemnations of the use of Dakin's solution are those most ignorant of its use.

Comparison with Other Methods. The method described by Phillips[9] is much like that described by Immerman except that a metal cannula is left in the chest wall during the course of treatment.

In the Diederich method by means of a special trocar and cannula the rubber tube is introduced indirectly by passing beneath the skin and fascia then over the top of the rib before entering the pleural cavity. This he claims acts as a valve to prevent entrance of air but allow egress of fluid. We think no tube soft enough to collapse here should be used, for if the tube would collapse under such condition it would be an easy matter to force fluid by compression into the cavity but difficult or impossible to remove it, because under suction the compressed tube would further collapse and thus prevent the suction from reaching the pleural cavity. The treatments are less frequent, less intense and no formaldehyde solution used. The operations are delayed and repeated aspirations made until the patient has passed the crisis. Glass piston syringes are used.

The method of repeated needle aspirations with or without the injection of an antiseptic always means pain and a long convalescence with possible numerous complications. A case which can be cured by repeated aspirations alone in from four to ten weeks can usually be cured in as many days by the closed method.

The open method with its numerous modifications, whether costectomy or thoracotomy, is gradually becoming more in disuse for some form of occlusion treatment. The writer believes that the time will come when rib resection as a routine in acute empyema will be considered malpractice. Many advocate simply drainage, with or without irrigation. Others add sooner or later some form of negative pressure. The three-bottle gravity system which to a certain extent affords constant drainage is perhaps the most common of these methods. Caples, of New York, claims this method gives a pull of 20 mm. of mercury and that the normal negative pressure of the chest is 8 mm. The negative pressure of the bulb syringe is about 60 mm.

The large open wound not only necessitates large expensive dressings frequently changed but invites contamination and cellulitis, in addition to systemic infection from the wound itself. The shock following the collapse of the lung, further embarrassing respiration, not infrequently causes death within a few minutes or hours.

Most advocates of the open method are agreed on delayed operation preceded by repeated aspirations, as indicated, until the pneumonia subsides, and adhesions form to limit the collapse of the lung, making the operation more safe. This delay and repeated aspira-

[9] Jour. Am. Med. Assn., May 3, 1919.

tions are not only unnecessary, by the closed method, but are decidedly harmful to the patient because of increased chances for complications. It is quite impossible to completely empty the chest by needle aspiration, as there is always danger of puncturing the lung with possible resultant bronchial fistula, pressure symptoms are only temporarily relieved, as a rule, the pleura gradually thickens, pus pockets form, the absorption of toxin continues and many complications might arise which are too frequently offered in the necropsy report as an alibi for this procedure, as the cause of death.

Major Stone, Chief of the Medical Service, Base Hospital, Fort Riley, Kansas, reported[10] 310 cases of empyema, 37 of which were cured by aspiration alone and the remaining 273 cases were operated by the open method with a mortality of 48 cases, or 17.5 per cent. He also reported in the same article 100 deaths from empyema cases, which, as he states, "were not considered suitable risks for any kind of an operation except aspiration."

By virtue of a fair comparison with the writer's 2 per cent. mortality in a series of 45 acute empyemas of the above series would be 410 cases, with a mortality of 148 cases, or 36 per cent. This rate is perhaps a fair average with the open method when all cases are included, as they should be, and it is in keeping with the statement by Lilianthal[11] that a mortality lower than 25 per cent. in acute empyema may be considered good.

The writer has never seen an empyema case too serious to be operated by the closed method, and has operated early at least 25 cases, which either had an active pneumonia or some other serious complication with but a single death. In no case was there collapse of the lung or the slightest sign of shock, and all showed immediate improvement. There is every reason to believe that if all such extreme cases were operated by the trocar method most of them could be saved, even though a secondary operation, by rare chance, might be necessary.

Although the writer has had but 1 death, a bilateral case, in 45 acute cases, and 1 death, a bilateral case, in 93 chronic cases treated by the closed method, he believes that this extremely low mortality rate would obtain in even a much larger series of cases. Especially would this be true if the bad risks were not operated and only those cases operated as is usually done with the open method, who, by virtue of their own natural resistance or otherwise, have been enabled to survive the critical period and become good operative risks. Such practice, however, is believed to be not only a surgical sin but criminally wrong when early operation by the closed method offers quicker and better results, and a much lower mortality.

[10] Am. Jour. Med. Sc., July, 1919.
[11] Military Surgery, June, 1919.

Conclusions. 1. Early operation by the closed treatment method has the following advantages:

(*a*) It can be done, regardless of the stage of pneumonia or serious condition of the patient, without the least shock or collapse of the lung.

(*b*) It provides complete evacuation of the empyema cavity, relieves cardiac and respiratory embarrassment and prevents the absorption of toxins and the usual resultant complications.

(*c*) It lessens the usual thickening of the pleuræ and prevents the lung, compressed by the exudate, from becoming fixed in compression.

2. The closed method has the following general advantages.

(*a*) Productive of great economy of time, labor and dressing material.

(*b*) Causes the minimum pain and discomfort to the patient.

(*c*) The dressing is small, lasts several days, without skin irritation and does not constrict the chest.

(*d*) Uncomplicated cases of empyema are not kept in bed.

(*e*) Cases are less likely to have recurrence, become chronic, or need a secondary operation.

(*f*) The constant negative pressure gives maximum expansion of the lung.

(*g*) The scar is very small and there is no chest deformity.

(*h*) Practical in the home and in country practice.

(*i*) The postoperative treatment in greater part may be done by a nurse or a properly instructed member of the family.

(*k*) Bacteriologic and roentgenographic laboratories, while always to be preferred, are not absolutely essential.

(*l*) The mortality is lower than by any other method.

(*m*) Can effect cure in acute bilateral empyema, both sides being operated at the same time, with acute bilateral pneumonia present, which treatment is impossible by the open method.

3. Dakin's solution, because of its great solvent and bactericidal action, is the most nearly ideal solution to use in the preliminary treatment of the empyemic cavity to dissolve the fibrinous exudate and partially sterilize the cavity.

4. Liquor formaldehyde in glycerin, 2 per cent. dilution, is the best solution to use in the empyemic cavity after the preliminary treatment with Dakin's solution, to complete sterilization, shorten the course of treatment and prevent a recurrence.

5. Smears and cultures after the formaldehyde solution treatment is begun will each show a rapid decrease in the number of bacteria, which are sometimes found two or three days in the smear after the culture will be sterile.

6. Bronchial fistulæ are more common than is generally suspected. With this complication salt solution should be used in amounts as large as possible and not cause the patient to cough.

7. A hypochlorite solution of increased strength over Dakin's solution in both alkalinity and available chlorin can be used in the empyema cavity with safety.

8. The available chlorin in Dakin's solution after injection into the empyemic cavity rapidly decreases. The strength after one minute averaged 0.38 per cent. and after five minutes 0.07 per cent.

9. Dakin's solution can be made with sufficient accuracy from various commercial products by those who do not have the usual facilities for making and testing this solution.

10. The progress of acute cases when less frequent treatments were given indicates that cures can be effected in a little longer time by giving only one to three treatments daily.

11. Cases becoming chronic following open operation generally can be cured in a comparatively short time by instituting the closed method treatment, so making unnecessary a major secondary operation of the Schede, Eastlander or Delorme type.

POST-NATAL DEVELOPMENT AND PATHOLOGICAL ORGAN RECONSTRUCTION IN RELATION TO FUNCTION AND DISEASE.

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Introductory Note. I present in the following pages a collective review of the results of investigations which have been carried on in my laboratories for a number of years, dealing with the constitution of important organs of the body at various age periods in health and in disease. Although incomplete, they have reached a point of practical interest, especially in the interpretation of pathologic function. It was therefore considered wise to collect at this time the evidence from various scientific journals and to place its general bearing and that of related subjects by other authors before a larger medical audience. Those interested will find the references to the documents in the case appended.

I. It is known that man during his post-natal existence passes through several more or less well-defined, great age periods, of which six are generally recognized:

1. Infancy: The period of extrauterine dependency upon the mother to the time of independent nutrition and motion (seven to ten months).

2. Childhood: The period extending to the time of second teething. Comprises beginning and development of independent motion, speech and senses (seven years).

3. Presexual Age: The period from end of childhood to beginning of puberty (the thirteenth to sixteenth year).

4. Puberty: The period extending to the end of length growth and sexual development (the twentieth to twenty-fifth year).

5. Maturity: The period of full individual development to the time of sexual cessation (about the forty-fifth year in the female and uncertain in the male).

6. Senility: The period of external decline to death.

In each of these periods the organization of the body possesses physical (anatomic) characteristics of its own. Certain structures atrophy, degenerate, waste by physiologic inflammation and are lost. New tissues appear or older structures acquire greater prominence, so that the relative importance of remaining organs is shifted.

The pathologic importance of these age periods has also been appreciated in a general way. Thus, infantile diarrheas and marasmus occur at the time of beginning independence from the mother when the gastro-intestinal tract and the organs of metabolism are forced to adapt themselves to the new environmental influences. Thus, also, infants, children and youths in whom the lymphoid tissue is highly developed display greater tendency toward infections which anchor with predilection in the lymphatic apparatus. Diseases of bones, either nutritive or infective, make their appearance mostly during the unstable period of active bone growth in which, moreover, the arrangement of the juvenile circulation exposes them particularly to entrance and arrest of infecting agents. It may be recalled in this connection that Lexer[1] and others obtained in young animals through simple staphylococcus injection into the blood an acute osteomyelitis which was associated with other manifestations of pyemia similar to those in children. The infective foci appeared, moreover, in those parts of bone formation which exhibit most active growth—that is the area between epiphysis and diaphysis which Kocher has named metaphysis. It was subsequently found that this area possesses in young bones a particularly well-developed system of end arteries which, taking their entrance from the periphery, advance by abundant arborescent division into the metaphysis. Embolic infection is therefore relatively easy in young, growing bones. In the adult, more stable, long bones this circulatory arrangement is reduced to lesser importance.

[1] Die Aetiologie u. d. Mikroörganism der Akuten Osteomyelitis, Sammlung Klin. Vorträge (Volkmann), Neue Folge, 1897, cliii. Die Entstehung entzündlicher Knochenherde und ihre Beziehungen zu den Arterienverzweigungen, Arch. f. klin. Chir., 1903, p. 71. Kaufmann: Lehrbuch d. spec. path. Anat., 1911, ii, p. 685 (with extensive literature).

Corresponding to this anatomic change, Lexer observed that blood infection in older animals produced no osteomyelitis but a pyemia with joint and muscle manifestations and involvement of parenchymatous organs (liver and kidney). The conditions were therefore similar to blood infections in the human adult.

But not only early life stands under the influence of the age period: The whole time of puberty is largely under the ban of sexual development (chlorosis and mental diseases), and when in old age the tissues and organs experience the effects of wear and tear, the ground is prepared for the great group of involutionary diseases, arteriosclerosis, cancer and other senile atrophies and degenerations.

All these facts and similar evidence are well known, and I only mention them once more in passing. But it appears less appreciated that at least some of the important organs which persist through human life, and which we picture in our minds as more or less fixed in form and of a definite, permanent structure, in reality undergo important qualitative cell and structural modifications in different age periods, and that even within these periods organs are never absolutely fixed in structure and organization, but always fluid, constantly in regression and progression, ever changing.

Some years ago before I was fully aware of these facts and of their extent and importance, Dr. Lindsay Milne surprised me with some results of investigations he had carried on in my laboratory in New York on the histology of ductless glands, more especially the thyroid and suprarenal. He came to the conclusion that an absolute normal standard could not be found and that some changes which other investigators had put down as abnormal or as a disease might still come within physiologic limits. Similar conclusions were reached by Coplin in a study of the human thymus and by Theilhaber on the varying construction of the normal human endometrium.[2]

At about the same time I had occasion to examine the pancreas in several cases of severe diabetes mellitus in which the organ showed a marked not inflammatory, simple atrophy and collapse of architecture the cause and explanation of which remained obscure.[3] It was not until Anderson and I[4] stimulated by Reitmann's excellent study on regression and progression in the normal pancreas[5] began to investigate the same problem that a probable explanation of this simple but essential atrophy occurred to us.

In conformity with Reitmann's results we found the normal

[2] Oertel: Degeneration, Senescence and New Growth, Jour. Med. Research, July, 1918, xxxviii, 3 (quotes the other literature in this connection).

[3] Oertel: On Certain Changes in the Pancreas in Diabetes Mellitus, etc., Scientific Reports, Royal Victoria Hospital, 1916, Series B, i, 155.

[4] Oertel and Anderson: Regressive and Progressive Changes in the Pancreas etc., ibid., p. 163.

[5] Beiträge zu Pathologie der menschlichen Bauchspeichel drüse, Zeitschr. f. Heilkunde, Abth. f. path. Anat., 1905, xxvi, 1.

pancreas from infancy to old age a very unstable organ. Degeneration, atrophy, cell loss and acinar collapse are, to some extent, normal performances. But they are almost simultaneously compensated by formation of new cells, new acini and, in the growing, youthful pancreas even by formation of new lobules. Thus in the normal pancreas these processes are, as Reitmann first properly pointed out, balanced and coördinated, although, as Anderson and I had occasion to record, even there certain localized restricted abnormalities or faulty reconstructions may be noted.

The changes which I had previously discovered in the atrophic diabetic pancreas were similar to those Anderson and I saw in the normal organ. Only they had assumed much greater, diffuse and profound proportions and the regenerative attempts had remained incomplete, aborted and unbalanced. One could therefore in absence of any outside etiologic factor or inflammatory or nutritive interferences, interpret this pancreatic atrophy as an exaggerated, unbalanced physiologic performance, and it was possible to conceive a relation of such a condition to tumor growth.

An extensive investigation into the histology of the human spleen was subsequently carried out by Dr. Gross.[6] Guided by our previous experience he set out to investigate three problems: (1) Is there a coherent cycle of changes in this organ in health during various age periods? (2) Is there any specificity in its reactions in disease? (3) Do the reactions of the spleen in disease differ with the age of the individual?

I refer to the original for detailed discussion and the tabulated and charted records of his result. It suffices here to emphasize that all these points were answered in the affirmative. So marked are the changes in all elements and organization of the spleen from infancy to old age that the two representatives at either end show little in common. To quote Gross's conclusions: "In early life the spleen, with its numerous endothelial buds, germinal foci in its Malpighian corpuscles, abundant capillary system and lymphoid elements, resembles granulation tissue. In its great vascularity it seems to have a structure admirably suited for thorough intermingling of blood and pulp. *Notable is that during this period the spleen does not react markedly to infection.* With progressive age the spleen becomes anatomically more unsuited to intimate contact with the blood. Bloodvessels thicken and become hyaline, the amount of lymphoid tissue, especially in size and number of Malpighian corpuscles, steadily falls, the splenic pulp gradually collapses and thus becomes relatively prominent. The trabeculæ are also made more conspicuous, both by relative prominence as well as by actual increase in fibrous thickening.

"Thus it appears that functionally the spleen becomes more

[6] Studies on the Gross and Minute Anatomy of the Spleen, Jour. Med. Research, January 3, 1919, vol. xxxix.

passive as age advances. But it is interesting that *the spleens of middle age show reactive exudative and proliferative phenomena in disease, in contradistinction to the behavior of young spleens.*

"In old age, finally, the spleen has undergone such marked regressive changes that its reactions and participations in disease are only very sluggish and uncertain." In other words, the adaptability of the spleen to environmental influences is, on account of its organization, greater when young. Its reactions, however, are greatest in middle age.

A number of observations which Dr. Waugh[7] recently conducted on the bone-marrow gave similar instructive results and added to our previous knowledge of bone-marrow changes.

He found that the normal bone-marrow is to about thirty years of age parenchymatous and myeloplastic in structure, although it may grossly appear fatty. That is, it gives the appearance of an actively functionating organ of the hematopoietic system. As age advances the bone-marrow becomes increasingly fatty, never fibrous. Fat contents and parenchyma stand in inverse proportion. Young marrows show no fat. In later years (after thirty) this increases at the expense of the parenchyma, appearing first in islands between the parenchyma and thereafter shows many variations in its diffuseness and extent.

As far as erythroplasts are concerned these are numerous in young marrows, but this abundance drops off quickly as the second age period is reached. Apparently the erythrogenetic function is not maintained in normal marrows to any great extent after puberty. But there is some evidence which, however, must still be confirmed by future research that this function in the adult rises and falls periodically in wave-like exacerbations of proliferative activity even in later age periods. Very interesting is that the erythroplastic function in disease does not seem to depend upon loss of blood cells alone but upon the character of the disease and the ability of the tissues to respond. Thus in infantile inanition, nephritis, endocarditis, goiter, or cancer low red blood cell counts in the marrow were recorded (as low as 3 per cent.). On the other hand in nearly every case of acute infection and in tuberculosis the count was 25 per cent. or over. In typhoid fever the values were low.

In other words regression is by itself insufficient to instigate or release growth, and either additional stimulating influences are necessary or proliferative attempts are extinguished by the same pernicious influence.

Lymphocytes occurred only in about the proportion in which they circulate in the blood. Plasma and endothelial cells (phagocytes) were seen only in abnormal conditions.

[7] Studies on the Bone-marrow in Disease, McGill Medical Society, Senior Prize Essay, 1920.

The general conclusions which Waugh drew from his observations in different diseases, which I need not consider in detail here, were that the reactions of the bone-marrow are not uniform in various age periods, but necessarily vary with the temporary constitution of the marrow at the time of the disease and also with the irritating effect a particular disease may exert upon a bone-marrow of a certain constitution.

The organs which we have so far considered concern acinar and rather loosely combined cell structures in which stability may easily be upset through looseness in texture and which are open to easy environmental influences. But how does it stand with organs in which firmness and compactness combined with simpler uniformity of structure exists?

In other words are anatomic changes in age periods a general phenomenon in life of organs or are they confined to organs of loose and easily dislocated structure?

In order to contribute something to an answer to this question, Dr. Gross has carried on for several years a study of the circulatory tree of the heart in relation to its musculature and structure. He employed for this purpose a method consisting of a combination of an elaborated and perfected method of Spalteholz, with stereoscopic skiagraphs whereby very exact and detailed pictures may be obtained.

His results, which are now ready in monograph form,[8] contain much useful information in regard to the structure and function of the heart in health and disease which I need not record here, but he has shown conclusively that in regard to its circulation and musculature the heart undergoes very profound changes from birth to senility. Briefly expressed these are—that the arrangement of the circulatory tree and, therefore, the blood supply which at birth are evenly distributed, are gradually shifted from the right to the left side, so that, as life advances, the left side becomes stronger in blood supply and musculature, the right side weaker. The senile heart possesses only a very small, insufficient right-sided supply. He has further pointed out how the auriculoventricular bundle (the so-called bundle of Kent or His) is originally provided for, how it is influenced by this altering blood supply and just how far and how extensive coronary anastomoses exist. So that, for example, the extent of interventricular septal anastomoses is an index of the age period.

Many pathologic functional disturbances are made clearer by this knowledge and by a comparison of pathologic hearts, prepared by this method, with others representing types of corresponding physiologic age periods.

With regard to kidney and liver I am so far only able to offer one

[8] Gross: The Blood Supply of the Heart (in print). New York, Paul Hoeber.

or two more general, fragmentary statements. In the kidney we possess as yet no systematic detailed and classified knowledge, so that we are unable to state whether well-recognizable modifications for various age periods occur. There exists, however, evidence which points to the fact that its structure is not stable and permanent throughout. While glomeruli have already been found in embryos of 3 cm., they are said by some embryologists to be still forming after birth and to continue so far several weeks of infantile life. These new glomeruli are at first of very large size; after a year all glomeruli are of about equal size (140 μ). Thereafter, from the second to the twenty-third year a uniform enlargement follows (to 240 μ). In the newborn, glomeruli are only 118 μ.[9] We do not yet know whether there exists a general diminution in old age. Herxheimer[10] has drawn attention to the frequent occurrence of hyaline glomeruli in the kidneys of infants and young children. He held them to be result of developmental anomalies, whereby the normal union between glomeruli and tubules has been interrupted. Since we are acquainted with the fact that in the fetus glomeruli and tubules form at first very rapidly, but, as Chievitz has shown, undergo in part regression and disappear, it seems more probable to regard these hyaline glomeruli as remnants of reduced renal substance. Similar hyaline glomeruli are seen in otherwise healthy adult kidneys without arterial disease.

Whether tubular reduction and reconstruction occurs to any extent in extrauterine life seems very doubtful. Actual new tubules are not seen to regenerate themselves after renal destruction, although the lining epithelium, especially of the convoluted tubules, possesses high regenerative activity in health and disease.[11]

In the liver also we are as yet not sufficiently well informed to speak of or recognize a definite cycle of developmental events. But the frequent findings of localized cell regression and cell proliferation (as indicated by nuclear and cell division and differences in number, arrangement and proximity of cells in a unit) at least indicate here also a fluid condition. In an experimental investigation into pathologic changes in the liver of the rabbit in certain poisonings, carried on by me some years ago at Guy's Hospital,[12] I encountered many curious pictures in cell type and arrangement in liver lobules which were made clear after a study of a large number of normal and untreated rabbit livers from the collection of Dr.

[9] Felix, W.: The Development of the Urogenital Organs in Manual of Embryology by F. Keibel and F. P. Mall, Philadelphia, 1912. Die Entwicklung des Harnapparats (1904); in Hertwig's Handbuch der vergleichenden und experimentellen Entwicklungslehre der Wirbelthiere, Jena, 1906.

[10] Hyaline Degeneration der Glomeruli d. Niere, Ziegler's Beiträge, 1909, Bd. 45.

[11] Oertel: The Anatomic-histologic Processes of Bright's Disease, 1910, Philadelphia, p. 110, ff.

[12] Oertel: A Contribution to the Knowledge of Experimental Nephritis (Section on Pathologic Changes in the Liver of Untreated Rabbits), The Lancet, May 23, 1914.

Gordon Goodhart. It seems that these were physiologic performances. Recent observations of Weed[13] on the cells of the arachnoid discloses also definite qualitative structural modifications in advanced age periods, notably in the appearance of newly-formed endothelial cell clusters.

With this evidence on hand there can be no doubt that the parenchyma of important organs is in constant flux, not settled and fixed. Moreover, and this seems to me a very important point, it has been demonstrated that at least in some of these a gradual but profound qualitative architectural reconstruction occurs with advancing age.

What then is the significance of these observations? These fall under a general and a special group.

A. General Conclusions. 1. Organs which normally exhibit a cycle of developmental changes in cell elements and tissue organization undergo corresponding functional modifications. Pathologic, anatomic and functional changes must therefore be interpreted in conformity and comparison with an age period.

2. The anatomic peculiarities and the fluid state of organs in various age periods have an influence on their dispositions to disease. Upon these factors depend, at least largely, immunity or susceptibility of age periods. Moreover, waves of regression and progression may here be of importance through upset of structural balance.

3. Anatomic and functional expressions of a disease vary in one and the same organ according to its construction and composition during an age period.

B. Special Conclusions. 1. Diseases may arise from the fluid and changing state and age progress of organs by loss of balance in physiologic regression and progression.

2. Depending upon the pathologic predominance of one or the other group of changes, essential atrophies; hypertrophies; degenerations; and progressive, destructive cell proliferation (tumor growth), all of which are normal developmental processes, may be duplicated and exaggerated in post-natal existence.

II. Cell and architectural reconstruction of organs which, as we have seen, plays an impressive role throughout physiologic evolution, assumes an equally great, though different, importance in those organs which are the seat of long-continued, slowly progressing diseases, more especially in the large group of chronic, productive inflammations. I propose, therefore, to deal in this second section with the relation of pathologic organ reconstruction to pathologic function.

The productive, clinically chronic, inflammations acquire here the greatest importance, not only on account of their frequency, but because they lead to the most profound alterations in essential cell

[13] Johns Hopkins Bulletin, October, 1920, xxxi, 356.

elements and their arrangement. This has so far been definitely demonstrated in the kidney and in the liver, and it enables us to form a much clearer conception of functional derangements in these organs than we formerly possessed. Take, for example, the typical so-called primary or genuine contracted kidney. It is anatomically characterized by a progressive slow waste of parenchyma (glomeruli and tubules) and an abundant increase in fibrous connective tissue. That, briefly, is the essential tissue change, but we must, in order to appreciate its functional importance, construe the plan of the pathologic organ, for construction of an organ holds the key for understanding of its function not only in health but in disease. Here again the arrangement of the circulatory tree is basic.

The first one to draw attention to certain qualitative changes of the circulation in contracted kidney was Thoma.[14] He demonstrated that with obliteration of glomeruli occurred a short circuit in cortical vessels so that afferent and efferent vessels connect without flow through a glomerulus. Subsequently, Ziegler and E. Kaufmann noted the unusual dilatation of pyramidal vessels and attributed this to the elimination of cortical circulation. These findings did not, however, make clear the greater and more profound circulatory alterations which were finally discovered after several years of experiments in attempts to inject and visualize the whole arterial tree by plastic, stereoscopic reconstruction. The technic of this process may be consulted elsewhere.[15]

It was found in the first place that the prevalent idea of normal kidney vasculature, as based on older methods of serial reconstruction is erroneous, and that instead of arcuate arteries which were considered to give off straight vessels to the cortex and medulla the normal renal circulation resolves itself into an abundant dichotomous division of arteries. The main renal artery divides rapidly into branches. These run until they reach the cortex, maintaining almost to the last a uniform diameter. Here they abruptly divide into numerous branches perpendicular to the capsule, and at right angle to these, glomerular branches are given off. The whole arrangement is that of a spreading chestnut tree.

What is the arrangement in the contracted kidney?

In the contracted kidney the normal cortical circulation is gradually eliminated, the remaining bloodvessels becoming narrow, tortuous and coursing without regard to the parenchyma. Its place is taken by a transfer and readjustment of the circulation to the pyramids which are not involved in the cicatricial contraction. Thus in a well-pronounced case the pyramids represent about four-fifths of total renal substance. The readjustment is carried

[14] Zur Kenntniss der Zirkulationstörungen in der Niere, Virchows Arch., Bd. lxxi, p. 42.

[15] Gross: Studies on the Circulation of the Kidney, First Communication, Jour. Med. Research, July, 1917, xxxvi, 3.

out not only by compensatory dilatation of vessels and pooling of the blood into the pyramids but by bloodvessels which in the normal kidney cannot be detected. An abundant compensatory circulation appears also in the pelvic fat and extends to and communicates with the pyramids! This new blood supply follows less faithfully the intricate course of the tubules, so that the inflammatory contracted kidney presents not only quantitative reduction but qualitative reconstruction of kidney vasculature. Herein lies a great point of distinction between it and the arteriosclerotic shrinkage in which these qualitative changes are not to be observed. Associated with this rearrangement in circulation is reformation in the remaining parenchyma. As far as this is not lost it undergoes alteration in secreting structures and course of tubules. The epithelium of the convoluted tubules regresses from a highly differentiated type to a low, syncytial, endothelial lining. Tubules are shortened, widened here, narrowed there, distorted in course, and not, as has already been said, accompanied by a normal, direct blood stream.

When we therefore consider these two essential groups of changes in contracted kidney (1) altered blood supply and distribution, and (2) loss and regression of secretory epithelium, with changes in the tubular course, we are in a better position to form a conception of this kidney function. For the new endothelial, membranous lining of the tubules can much less readily secrete the complex nitrogenous molecules which, moreover, it does not receive as directly as in the normal cortex. As much of these as is secreted will come from those parts of the renal substance which have as yet escaped the insults of the productive inflammation. It is therefore to be expected that the urine from these altered tubules is more of simple transudative character.[16]

In the medulla, on the other hand, instead of its normal simple and subordinated blood supply, appears an apparently new and enlarged network of blood channels which supplies the remaining loops of Henle and collecting tubules for compensatory and possibly new function.

Two of the most perplexing characters of contracted kidney—namely, the increasing abundant watery character of the urine and the increasing nitrogen retention which go hand in hand with parenchymatous waste—are brought nearer to our understanding. We have here the anatomic foundation for renal insufficiency and perversity.

In the liver also the tissue rearrangement in the productive inflammations commonly grouped as cirrhosis of the liver is profound

[16] Gross: Studies on the Circulation of the Kidney, Second Communication, Jour. Med. Research, xxxviii, 3.

and functionally important. This had become evident to Kretz some years ago.[17]

Here it must be remembered that the degenerative atrophy of parenchyma and formation of inflammatory scar tissue follows in no way the normal architecture. The old classification into monolobular and multilobular cirrhosis can no longer be maintained, for the replacing growth of inflammatory granulation tissue never follows, from beginning to end, the configuration of the normal liver lobule. To the contrary its invasion and the separation of liver lobules is quite arbitrary, always intralobular, cutting off parts of old lobules here and there and uniting them to new liver islands. In these islands old cells unite with newly formed atypical liver cells to a new structural unit in new relations.[18]

The distinction, therefore, between inter- and intra-acinar cirrhosis falls down, but we may only differentiate between circumscribed and diffuse cirrhosis. A better name for the former is "insular type."

Concomitant with these changes in cell architecture go obliteration and rearrangement of old blood channels and bile ducts. Here the changes in vasculature resemble those in contracted kidney in loss of old and appearance of a new circulation. Milne showed that so-called, newly formed bile ducts are, at least largely, old ducts which in the new cirrhotic environment alter their shape and course and become more conspicuous. While much more could be said about these and other matters in cirrhosis, it suffices to show that in the liver also the architectural plan of remaining parts is so altered and partly new that it no longer has resemblance to the normal parent organ. Liver function is therefore not only quantitatively reduced by loss of parenchyma but qualitatively altered by the cirrhotic reconstruction. Metabolic perversities are to be understood and explained on this basis. Finally, the investigations of v. Hansemann and especially Reitmann (*l. c.*) of certain forms of fibrous pancreatitis also point to an entire reconstruction of the organ.

Enough has, I think, been said to make it clear that the human organism is never a stable and fixed entity in its parts and organs and that its functions are not uniform but differ qualitatively in various age periods.

What applies in this respect to the physiologic organism applies in even greater and exaggerated degree to the pathologic body.

But inasmuch as all organs in health and disease stand in certain relations to each other, forming the unit upon which the personal individuality depends, it follows that progressive changes occur in these relations in health and disease and that age and disease are

[17] Kretz: Ueber Lebercirrhose, Wiener klin. Wchnschr., 1900, p. 2.

[18] Oertel: On Lymphangitis and Perilymphangitis of the Liver, etc., Arch. Int. Med., 1908, i, 390.

anatomic expressions of reconstructed organs and of altered organ relations.

It has been said that the days of morphological investigation are over. I trust I have, although inadequately, indicated, that cultivation of morphology is as important for scientific vision today as it has been in the past and how much still remains here to be done.

THE TRANSFUSION OF BLOOD WITH REPORT OF 186 TRANSFUSIONS.

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The brilliant results of human blood transfusion during the past few years and the ease with which this operation can be performed by any one of a number of modern methods has made it one of the most frequent procedures in practical medicine and surgery.

History. The early literature on the subject of transfusion is rather indefinite. In the year 1492 an attempt was made to prolong the life of Pope Innocent VIII by transfusion, which was unsuccessful. The lives of three donors were sacrificed in the attempt. A. H. Matthews, in the *Life and Times of Rodrigo Borgia*, flatly denies this occurrence. There are no convincing records of any transfusion being done before William Harvey's important discovery of the circulation. It was not until 1616 that Harvey presented his views to the College of Physicians, and it was 1628 when he published his treatise on *Motion of the Heart and Blood*.

Mention is made of transfusions by an Italian physician, Francesco Folli, in 1654, and by Daniel of Leipsig in 1664; but most historians give the credit to Wren of conceiving the idea of using infusions in bloodvessels and to Richard Lower, of England, and Jean Denys, of France, of being the first to really carry out the procedure. Lower carried out the first transfusion experimentally on dogs in 1665, and in 1666–7 Denys first successfully transfused a man by using lambs' blood. Lower used a cannula and connected the artery of one animal to the vein of another.

Samuel Pepys, on November 14, 1666, recorded in his diary that "at a meeting of Gresham College . . . the experiment of transfusing the blood of one dog into another was made before the society by Mr. King and Mr. Thomas Coxe upon a little mastiff

and a spaniel, with very good success." On November 21 he records that "the spaniel was produced and found very well." Again, on November 21, 1667, Pepys wrote of a "Poor and debauched man that the college had hired for twenty shillings to have some of the blood of a sheep let into his body . . . their purpose to let in about twelve ounces, which they compute is what will be let in in a minute's time by the watch." This was probably the first human transfusion done in England. It was accomplished by means of a cannula, at a meeting of the Royal Society at Gresham College, on November 23, 1667. The transfusion, according to Pepys was evidently successful.

There then followed many years of use and disuse, of success and failure. Animal to animal, animal to man and man to man methods were attempted. Some were done by means of a cannula, but the majority were done by the indirect method. That the failures were far greater than the successes can be seen in the action of the French Government, which forbade the procedure until the Faculté of Paris should give its approval.

Blundell, in 1817, reported seven cases of transfusion with human blood done for postpartum hemorrhage, three of which resulted in recovery. His apparatus consisted of a syringe connected by a two-way stopcock to a receptacle and to a tube, in turn connected with a cannula for insertion into the vein of the recipient. He had no means of preventing clotting. He reports that Goodridge used this method before him.

Sheele, in 1802, and Diefenbach, in 1828, wrote extensively on the subject of transfusion. Dumas and Prevost, in 1821, first showed the injurious effect of injecting the blood of an animal of one species into that of another. In 1835 Bischoff introduced the method of defibrination, and in 1848 Diefenbach also advised this method. Later Panum, Prevost and Brown-Séquard, after numerous experiments, decided that the process of defibrination was the chief factor in the performance of a successful transfusion. In 1863 Blasius reported 116 transfusions, all done in the previous forty years, 56 of which were successful. All of these were indirect transfusions. Two were from animals and were reported as successful. Fourteen cases were done with undefibrinated blood, all of which were unsuccessful. During the Franco-Prussian War, 37 transfusion were reported. All of these were done with defibrinated blood, and 13 were successful. Geselius and Hasse, in 1874–1875, respectively advised the use of animals' blood for transfusion, lambs' blood generally being used. No attention was paid to any reactions which would at this present day attract our immediate attention.

From 1863 to 1884 transfusion was supposed to be a "cure-all," and the claims made for it were preposterous. It was not until Landois, in 1875, demonstrated that the red cells of one species

when injected into a different species of animal are destroyed that all attempts at transfusing with heterogeneous blood cells were discarded. Panum, Landois and numerous other writers noted that blood of the same species might functionate normally if used for transfusion.

It was not long before the inadvisability of using defibrinated blood was discussed. Magendie, in 1838, noted several of the untoward effects after its use. Köhler, in 1877, made the important observation that the use of defibrinated blood or serum, even from animals of the same species, increased the danger, because of the excess of fibrin ferment injected, and therefore the increased tendency to intravascular clotting. Landois, Geselius and Ponfick agreed with this. Cohnheim, in 1883, in reviewing the literature, stated that it was inexcusable to use any blood for intravenous injection in which clotting had already taken place. But until von Bergemann, in 1884, published his important work, transfusion was still a subject of great interest. He reviewed the entire literature and came to the conclusion that the only reason there were not more fatalities was because in most cases not enough fibrin ferment had been introduced to produce extensive intravascular clotting. He came to the conclusion that the only permissible transfusion was the direct one from artery to vein. Such death-blows to a process already on the wane because of the frequency of its disastrous results, together with the fact that the use of saline solutions for intravenous injection was becoming more general, caused the transfusion of blood to be abandoned as a therapeutic measure.

From that time up to the beginning of the present century, transfusion is only rarely mentioned in the literature, and then chiefly as a matter of historic interest. In 1898, Crile, of Cleveland, began a series of experiments which marked the introduction of transfusion as a safe and valuable therapeutic procedure. He began by using arteriovenous suture, which came into existence through the work of Payr and Murphy. He later adopted the ring-cannula method, first suggested by Nitze in 1897 and carried out by Payr in 1900. Jensen, in 1903, experimented with several methods, and in his report favored suture technic. Höpfner, in von Bergemann's clinic, in 1903, used the ring method in twenty-eight cases and concluded that it was not applicable to vessels smaller than 3 mm. in diameter. The technic of vascular anastomosis became so perfected through the work of Carrel, of the Rockefeller Institute, that this method, in the hands of men experienced in bloodvessel surgery, came into vogue. In 1907, Watts reported four cases by this method. Crile's cannula method, as well as Carrel's method, presented so many technical difficulties for the average surgeon that other methods were sought for. Crile's cannula was modified by Janeway, Elsberg, Soresi, Bernheim and Levin. Elsberg's modification was undoubtedly the best.

Then in rapid succession followed the glass-cylinder method first advocated by Kimpton and Brown in 1913 and later by Vincent and Percy, with their modifications. After this, in 1913, came the syringe-cannula method of Lindeman. Ziemssen used this method twenty years before, but it never became popular until revived by Lindeman. After this, in 1916, came the simultaneous work of Lewisohn and Weil in this country, of D'Agote in Buenos Ayres and of Jeanbrau of Montpelier on the use of sodium citrate as an anticoagulant. Heretofore hirudin, ammonia and oxalates had been advised and used as anticoagulants, but each in turn had been discarded. The work of these four men reopened the entire subject of transfusion. At this same time (1916) Satterlee and Hooker described their pipette-cannula method.

Since then the modifications have been too numerous to mention. Brenziger, Martin and Lee, and Unger have described useful modifications. The chief fact to come out of all the recent work, however, is the fact that nearly all the blood from donors can be obtained by the needle, using one of the many described, and that in at least a large percentage of cases the blood can be given by the needle, thus avoiding the destruction of a useful vein.

Indications. Now that the initial enthusiasm for a newly rediscovered procedure is over we are better able clearly to define the indications for transfusion. As Bernheim has said, the indications depend upon the surgeon's knowledge as to "when the limit of bleeding has been reached; and by the limit I refer to progressive anemia of any sort, from any cause."

We have found the indications divisible into three groups, and increased experience in the procedure will give the clinician definite ideas of the types of cases which will benefit by it.

I. *Loss of Blood.* To this group belong all those cases of anemia from acute hemorrhage as well as those cases due to small, long-continued blood losses. Some of the latter, however, finally fall into the second group.

II. *Diseased Blood.* Transfusion for this group serves the following functions:

1. To stimulate hematopoietic function.
2. To increase coagulability.
3. To add to the oxygen-carrying capacity.
4. To increase the bactericidal or antitoxic properties of the blood.
5. To increase the general nutrition.

III. *Shock.*

I. Loss of Blood. 1. Blood transfusion is invaluable in acute hemorrhage after injury or operation. In this group belong the hemorrhages of childbirth, ectopic gestation, miscarriages, fibroids and other uterine hemorrhages. Acute bleeding from injuries, from gastric, duodenal or intestinal ulcers, and from rup-

tured viscera belongs here also. It is in these cases of acute massive hemorrhages that the surgeon sees the most miraculous results. One of our cases admitted cold, pulseless and unconscious after a crushing injury to the thigh was revived by transfusion of 2100 c.c. of citrated blood. These cases can be operated on much more safely and the convalescence is much more rapid with a transfusion than without. The average amount of blood which we use for transfusion in acute hemorrhage is 750 to 1000 c.c., although, as noted above, one of our cases had 2100 c.c. This, however, was distributed over a period of twelve hours. Free blood in the abdominal cavity, if uncontaminated, can be filtered and citrated and used to transfuse the patient.

The question as to when to transfuse for acute hemorrhage depends upon the surgeon, but we believe that if all borderline cases were transfused the mortality from acute hemorrhage would be less. A pale, cold, clammy patient, with a weak, rapid and thready pulse, dyspneic and often cyanotic, with a low red cell count and hemoglobin and a systolic pressure of eighty or below, should be transfused as soon as a suitable donor is found. This will not only make up for the blood loss but it will also undoubtedly help to check the hemorrhage, provided the amount of blood given is not too large or given in too short a time.

2. In the repeated small hemorrhages the anemia may become so aggravated that the blood picture will simulate that of a primary anemia. Transfusion before the hemorrhage is controlled, and after this until the blood picture again assumes a somewhat normal appearance, act nearly as specifically as in the first group. In cases of chronic bleeding the coagulation mechanism becomes deranged and the longer the bleeding continues the less likely it is to stop spontaneously, although the coagulation time of the blood outside of the body is but little delayed.

In these cases we transfuse repeatedly once or even twice a week, until the blood picture shows that the blood-forming organs are again functioning normally. In this way an apparently poor surgical risk may be turned into a good one.

II. Diseases of the Blood. Here the new blood acts as a therapeutic agent.

(1) Hematopoietic Function. In this subsection belong the primary anemias and extreme secondary anemias. The transfusion is done with the hope that it will stimulate hematopoietic function. This probably occurs through the products of blood disintegration which stimulate the bone marrow. Several transfusions are necessary and it is often noted that the second transfusion is of much more benefit than the first. In this type of case we welcome a moderate reaction, since these patients seem to get the best ultimate results. For this reason some writers advise small doses of incompatible blood.

(*a*) Primary Pernicious Anemia. Vogel and McCurdy in 1913 first carefully studied the effect of blood transfusion and regeneration in primary pernicious anemia. In our series of cases we find that, while transfusion is of no permanent value, by repeated transfusions we have prolonged a patient's life for as long as four years. This patient has had sixteen transfusions, in this period, and is still able to go about. We feel that transfusion offers more for pernicious anemia than any other form of treatment. The remission which is brought about comes sooner and lasts longer, as a rule, than one occurring under medical treatment alone, and the life of the patient may be saved for some years.

If a remission is not brought about it is well to change donors. In this way results can be obtained by transfusion which make it superior to any other therapeutic measure. The important thing to remember is that under no circumstances should the patient be allowed to become so weak that transfusion is a dangerous procedure, but when the red cells continue to decrease and the hemoglobin reaches 30 it is time to begin transfusions.

(*b*) Aplastic Anemia. Here there is no tendency to blood regeneration, the leukoblastic and erythroblastic activity both being demoralized. Although blood transfusion does not even cause a remission in these cases, rapidly repeated transfusions (twice a week) will so increase the number of blood cells and hemoglobin, and relieve the symptoms that the patient can carry on his affairs for a variable period, though never a long one.

(*c*) Splenic Anemia. In this group we include splenic anemia and Banti's disease. Transfusion plus splenectomy offers the best opportunity for obtaining a cure. If the blood count is low after operation the transfusion may be repeated in order to give the blood-forming organs an impetus to resume their normal function.

(*d*) Leukemia. In our series we have had only one case of leukemia, that being a case of acute lymphatic leukemia. He was transfused four times, within ten days, with a total of 2200 c.c. of blood. When he was admitted his blood count was R. B. C., 905,000; W. B. C., 31,400; Hb., 25 per cent. On discharge his count was R. B. C., 3,600,000; W. B. C., 45,000; Hb., 33 per cent. However this improvement was only short-lived and an acute exodus followed soon after discharge. This is often the case and the most we can hope to do is to attempt to tide the patient over until the disease takes on a more chronic form and other treatment can be begun.

(*e*) Hemolytic Ictero-anemia. In this condition transfusion does not offer permanent relief but is of value in improving the anemia enough to warrant the operation of splenectomy, which is possibly a curative measure. Transfusion following the operation shortens convalescence and hastens the return of a normal blood picture.

(2) To Increase Coagulability. To this group belong the cases of (*a*) melena neonatorum, (*b*) hemophilia, (*c*) jaundice, (*d*) purpura, (*e*) secondary hemorrhagic diseases complicating such conditions as grave anemias, leukemias, and severe infections. It is in these hemorrhagic diatheses that we find the results of blood transfusion uniformly good. Melena neonatorum and hemophilia usually yield as if by magic to a single transfusion, although transfusion does not confer immunity to hemophiliacs against further hemorrhage. Citrated blood is just as efficacious in these cases as is unmixed blood. This has been definitely proved by Pemberton. If the first transfusion has not the desired effect, then a second one should be done with a different donor. Temporizing with less effective measures, as horse serum and various coagulants, may cost a life.

In our series we include a case of cholemia following cholecystectomy in which the patient had a number of fairly large hemorrhages. Her condition had become very serious when we decided on blood transfusion. There was immediate improvement in the patient's general condition and there were no further hemorrhages.

(3) To Increase the Oxygen-carrying Capacity of the Blood. Here belong the cases of illuminating gas-poisoning. Only a few cases have been reported. Carbon monoxide has a stronger affinity for hemoglobin than oxygen. When carbon monoxide combines with the hemoglobin the red corpuscle is removed from the circulation as effectively as in acute hemorrhage, as far as its oxygen-carrying capacity is concerned. The patient should be bled at the time of the transfusion. This may be difficult because the blood often becomes of a syrupy consistency. Our series of cases does not include any of this type.

(4) To Increase the Bactericidal and Antitoxic Properties of the Blood. Transfusion has no place in the acute infections unless the so-called "vaccination transfusions" suggested by Heyd and Hooker, that is, transfusion with immunized blood, open new possibilities. There is however, a large group of cases suffering from sub-acute and chronic infections which is materially benefited by transfusion. These cases, as a rule, are profoundly anemic, and transfusion should not be delayed until the body has lost its power of reaction. The transfusion is a stimulant to the hematopoietic organs, throws into the circulation functionating corpuscles and at the same time probably contains antibodies which may affect the life of the organism causing the infection, or so stimulate the patient's forces as to help them to develop an active immunity. Cases of chronic suppurating wounds do more than justify the procedure. We have used it in chronic suppurative disease of the hip-joint and in malignant endocarditis. The results would seem to justify further trial.

Antitoxic. For its antitoxic effect transfusion is of use in the toxemia of pregnancy with doubtful results, and in sprue, purpura and pellagra. While the beneficial effect is undoubted in purpura, in the other conditions the results are as yet doubtful. Lindeman reported four cases of tropical sprue treated by transfusion, with apparent recovery in every case. In the toxemia of pneumonia transfusion has been used with questionable results. Our only case, in extremity when transfused, died.

(5) As a Stimulant in the Various Cachexia. Here the transfusion is used for its general nutritive effect. It improves the vitality of the tissue cells. It frequently will permit radical operative procedure which before transfusion would have been out of the question. In debilitating conditions such as carcinoma it will improve the patient's general condition and prolong life. A field open to its use is the malnutritions of childhood, especially marasmus, and cachexia from prolonged diarrheas.

III. Shock. The value of transfusion in shock, especially if associated with hemorrhage, has received so much attention recently that it is needless to discuss it further here. It is just as useful in civilian as in military practice. In the cases of shock without hemorrhage, however, we must not expect as brilliant results as in those associated with hemorrhage. If an operation is necessary the patient who has been transfused is better able to stand the shock due to additional trauma.

DIAGNOSIS OF PATIENTS TRANSFUSED.

Pernicious anemia	32
Aplastic anemia	9
Hemolytic icteroanemia	2
(*a*) Both splenectomized.	
Splenic anemia	3
(*a*) Two splenectomized.	
Acute leukemia	1
Secondary anemia	4
Acute hemorrhage and shock	19
Acute infections	4
(*a*) Peritonitis.	
(*b*) Pneumonia.	
(*c*) Brain abscess.	
(*d*) Streptococcemia.	
Cachexia and chronic infections	8
(*a*) Marasmus (2).	
(*b*) Nephritis, chronic (2).	
(*c*) Hip-joint disease (3).	
(*d*) Infectious endocarditis (1).	
Carcinoma and sarcoma	2
Hemophilia	3
(*a*) One case of cholemia.	
Total	87

Amount of Blood to be Transfused. The amount of blood to be transfused depends upon two factors: first, the indication, and

second upon the receiving capacity of the recipient. The latter depends upon the condition and size of the patient. In cases of severe acute hemorrhage transfusions of large amounts of blood are indicated. We have given as much as 2100 c.c. in a period of twelve hours. This amount is often difficult to obtain but 1000 c.c. can be taken from a donor in good physical condition without any risk. In cases of secondary, primary pernicious or aplastic anemia we usually use 500 c.c. although if the transfusions are not at very frequent intervals we use 750 c.c. In primary pernicious anemia if the blood count is fairly high and the transfusion is given to stimulate blood formation small transfusions, as 250 c.c., are as efficacious as larger ones. In hemophilia 250 to 500 c.c. are sufficient. In melena the size of the transfusion varies from 10 to 100 c.c. Whole blood is most frequently given intramuscularly in this condition.

The fate of the transfused blood has recently been determined by Ashby. He sums up his conclusions by saying "The life of the transfused corpuscle is long; it has been found to extend for thirty days or more. The beneficial results of transfusion are without doubt not due primarily to a stimulating effect on the bone-marrow, but, it is reasonable to assume, to the functioning of the transfused corpuscles."

Selection of Donors. In choosing donors for the transfusion three laboratory tests are necessary: the Wassermann reaction, a blood count, and typing. In an emergency the first two may be omitted, but under no circumstances the last. Even in children, when a parent is the donor it is a wise precaution to take, although Kimpton states that children under two probably belong to no group. Cherry and Langrock have proved in a series of 34 cases that all mothers can be used as donors in transfusions of their newborn infants; and Kimpton says in thirty transfusions with only two exceptions he has used the father. Pemberton, however, states that the infant develops its own group after the first few weeks. The donor should be a robust young adult, with a negative Wasserman reaction and negative venereal history, and a blood count that is high normal. He must be either in the same type group as the recipient or in group IV.

The interaction of the donor's and recipient's cells and serum may be determined by the crossed hemolysis tests, and these tests must be carried out in all cases where the type reading is doubtful. The simple typing with known sera has proved so satisfactory if accurately done that only in a few cases have we used any other methods for determining the suitability of a donor's blood. The method of Vincent, based on the grouping of Moss, is the one which has been used in most of our cases. A drop of known type II serum is placed on one end of a clean slide and a drop of known type III serum on the other end. One drop of the patient's blood is then mixed with each drop of serum. The slide is rocked from side to side gently

for five minutes and then examined for agglutination. The type is determined by the following table:

Serum	I	II	III	IV
Groups I	−	−	−	−
Group II	+	−	+	−
Group III	+	+	−	−
Group IV	+	+	+	−

Moss has found in extensive observations that agglutination frequently occurs without hemolysis, but that hemolysis is always associated with or preceded by agglutination. If crossed hemolysis is done we use a modification of Rous' method of testing donor's blood for transfusion. Take two small test-tubes (1 x 5 cm.); in each place four drops of the following citrate solution:

Sodium citrate	1.5 gm.
Sodium chloride	0.9 gm.
Distilled water	100.0 c.c.

In one tube collect from the finger or ear one drop of the donor's blood and nine drops of the recipient's blood; in the other tube, one drop of the recipient's blood and nine drops of the donor's blood. Mix by shaking. Allow to stand for fifteen minutes. Take out a drop from each tube and place on a slide. Add a large drop of normal salt solution without mixing. Cover and examine under the microscope for agglutination. If desired, two drops of citrate solution and one drop of blood may be mixed in a third tube, as a control.

If there is no agglutination in any mixture, the transfusion is safe. If clumping is present in the tube containing nine drops of recipient's blood and one of the donor's, the recipient's blood agglutinates and may hemolyze the donor's blood and transfusion is dangerous. If clumping is present in the tube containing nine drops of donor's blood and one of recipient's it indicates that the donor's plasma agglutinates the recipient's cells. Transfusion under these circumstances is permissible since the donor's plasma is so diluted as to have little hemolytic power, but it is less desirable than where no agglutination is present.

Method. The method we describe here is the one in use at the University Hospital. After a donor has been selected he is placed on an ordinary operating-room table. The selection of the arm to be used depends upon the donor's choice and upon the suitability of the veins for use. The arm is extended and placed on a small table. The site is cleansed with a 95 per cent. solution of alcohol and then painted with a 5 per cent. solution of picric acid. A tourniquet is applied and sterile sheets are placed so as to surround the operative field.

A short length, large calibre aspirating needle is used to remove

the blood. We find this as efficient as any special needle designed for this purpose and the cost is considerably less. The needle is inserted into the vein against the current and the blood is collected in a suitable Erlenmeyer flask, which at the start contains one-half of the total amount of sterile sodium citrate solution to be used. We use enough of a 2.5 per cent. solution to make the end-result 0.25 per cent. While the blood flows into the flask the remainder of the citrate is dropped in with it by means of an ordinary pipette. The flask should be gently shaken during the collection of the blood (Fig. 1).

After the blood is collected the tourniquet is loosened and the needle removed. A small pressure bandage is applied. The flask containing the blood is inverted three or four times and then placed in a basin of water, the temperature of which is 120° F.

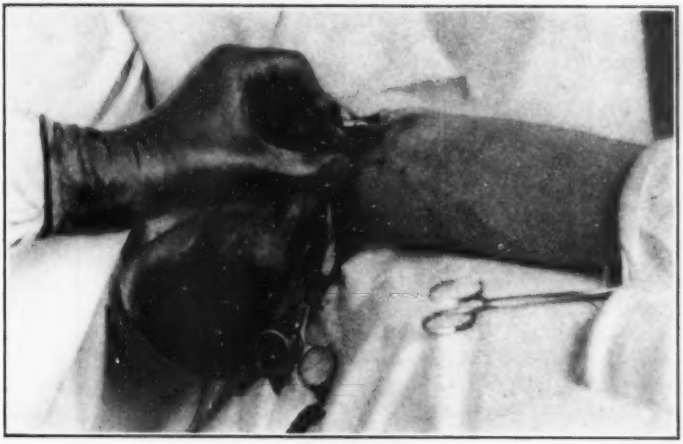

FIG. 1.

The recipient's arm is prepared in a similar manner, a tourniquet is applied, and if the vein is of sufficient size to allow it, a needle is used to introduce the blood (Fig. 2). If the vein is not large enough it is necessary to cut down on it and insert a glass cannula. This is, of course, less desirable where repeated transfusions are necessary because it destroys the vein for further use below this point. The skin is first infiltrated with a sterile solution of 0.5 per cent. novocain. The incision in the skin seldom needs to be longer than 1.5 cm. The vein is isolated by blunt dissection with a mosquito hemostat which is then inserted under the vein to carry the catgut ligature. The vein is tied off at its distal end while the ligature at the upper end is merely looped. Sharp-pointed scissors

are used to nick the vein in an oblique direction. A mosquito hemostat is applied to either side and to the apex of the triangular nick. While this is being done the assistant holds the proximal ligature taut so as to prevent unnecessary bleeding. The blood is introduced by gravity. A 250 c.c. cylinder containing a small amount of normal sodium chloride at 100° F., is used The cannula is inserted into the vein in the direction of the flow as soon as all air has been excluded from the apparatus and the flow of saline is

FIG. 2.

established. The tourniquet is now removed. The blood is poured into the cylinder, being filtered through several layers of gauze which have been placed over the top of the cylinder. Even though the blood has been typed and a crossed hemolysis has been done we stop the flow after the introduction of the first 25 c.c. to see if any immediate reaction occurs. If there is any reaction at this time the transfusion is stopped. The blood in the cylinder should be at a temperature of 110° F. and this may be accomplished by keeping the flask in a basin of water at 120° F.

After the blood has been introduced we again run in a small amount of sterile normal saline. The upper ligature on the vein is tied as the cannula is removed. The skin incision usually needs but one vertical mattress suture. In women accustomed to wearing short sleeves it is preferable to use the internal saphenous vein. This can be used for repeated transfusions, especially if the first incision is just above the internal malleolus.

When the vein is of sufficient size the same type of needle is used as that used in withdrawing the blood from the donor. It is inserted in the direction of the blood current. After the apparatus is prepared as above it is connected with the needle by a connecting piece.

In infants we have used the superior longitudinal sinus for the introduction of the blood. It is a very simple procedure and no untoward results have been observed.

Our series includes one arteriovenous suture, 47 transfusions by the Kimpton-Brown Method and 138 by the citrate method. We now use only the citrate method and consider this the procedure of choice. It is easy, safe, and as reliable as any method yet described.

REACTIONS.

None.	Mild.	Moderate.	Severe.	Death.
127[1]	45	9	3	2[2]

In properly typed individuals there should be no mortality unless the transfusion is attempted as a heroic measure in a patient who otherwise has no chance at all.

In an emergency where time means all and the typing sera are not obtainable 15 to 25 c.c. of the donor's blood may be injected into the recipient's circulation. If no symptoms occur within three to five minutes, the transfusion may be continued.

The symptoms of incompatibility are: (1) Dyspnea, (2) pain in the back, (3) abdominal discomfort and even pain associated with nausea and vomiting, (4) dilatation of the pupils, (5) sweating and flushing of the skin, (6) vertigo and throbbing headache, (7) puffiness of the face and eyelids.

Ottenberg and Kaliski report that in 10 per cent. of their cases "febrile reactions or urticaria and other skin eruptions occur." These they say are irrespective of hemolysis or agglutination and are probably due to fibrin ferment or blood platelet destruction. Two of the patients in our series developed herpes facialis the day following transfusion. A third patient repeatedly developed a

[1] A slight temperature with no subjective symptoms has been considered by us as no reaction.

[2] One by Kimpton-Brown method and one by citrate method. The deaths were both in cases of pernicious anemia. Since the writing of this paper one of the authors has had a mortality in another patient suffering from the same condition. The bloods were typed and cross-hemolyzed. The patient's condition, however, was most unsatisfactory. The temperature was 107° within six hours after transfusion and he died within twelve hours.

severe and annoying itching after each transfusion. Two developed bleeding from the gums with no other demonstrable symptoms except abdominal pain. Both of these recovered. In the serious cases jaundice and hematuria are evident if the patient lives long enough. Bernheim in 1915 in reporting 800 transfusions by 12 operators, found hemolysis in 15 cases with four deaths. Pemberton in reporting 1036 transfusions found 12 cases in which there were reactions, attributed to clerical errors in recording the grouping.

Meleny, Stearns, Fortuine and Ferry in a study of 280 transfusions find that the more transfusions a patient is given the more likely he is to have a reaction, especially if the same donor is used a large number of times.

The temperature after the citrate transfusions has gone up as high as 104° F. It sometimes goes down in a few hours by a form of crisis, other times it takes two or three days to reach normal.

Mortality due to transfusion—1.09 per cent. It should be stated here that there have been more deaths in the series, but these occurred some time after the transfusion and therefore must be attributed to other causes.

Mortality figures are of little value unless it can be shown that death resulted from hemolysis or agglutination directly after transfusion because this is an emergency measure in many cases and death may result from the condition for which transfusion was done.

CONDITIONS OF PATIENTS WHEN LAST HEARD FROM.

	Unimproved.	Improved.	Cured.	Died.
Primary pernicious anemia	1	23	0	7
Aplastic anemia	4	3	0	2
Secondary anemia	0	5	0	1
Acute leukemia	0	0	0	1
Hemolytic-ictero anemia	0	0	1	1
Hemophilia including case of cholemia	0	2	1	0
Splenic anemia	0	0	2	0
Acute infections	0	0	1	3
Cachexia and chronic infections	0	6	0	2
Acute hemorrhage and shock	0	0	14	5
Carcinoma and sarcoma	0	1	0	1
	5	40	19	23

Total, 87.

These records are not as accurate as they should be since there is no systematic follow-up procedure in the hospital. However some of the patients have been seen or heard from several years after their discharge from the hospital.

Conclusions. 1. With the element of risk practically eliminated blood transfusion has become one of the most effective procedures in modern therapeutics.

2. Transfusion is a specific in acute hemorrhage where the

"limit of bleeding" has not been reached, in melena and in the hemorrhage of hemophilia.

3. It is of definite value in primary pernicious anemia in hastening and prolonging remissions. It is indicated in cases of severe secondary anemia. After transfusion operations on debilitated or anemic individuals may often be safely undertaken that otherwise would involve serious risk.

4. Transfusion in shock is not as efficacious as in cases of shock associated with hemorrhage.

5. We have not been able to prove the value of transfusion in acute infections, but in chronic infections we have had results justifying its use.

6. Transfusion is of unproved value in acute leukemia. In aplastic anemia it is at the most a temporizing procedure.

7. The difference, as far as reactions are concerned, between the citrate method and the Kimpton-Brown method we have found to be practically nil and the simplicity of the former warrants its preference.

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A STUDY OF POLYCYTHEMIA VERA WITH SPLENOMEGALY, WITH A REPORT OF TWO CASES, AND A DISCUSSION OF THE TREATMENT BY THE ROENTGEN RAYS.*

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Definition. Polycythemia with splenomegaly is a disease in which there is an increase in the total number of red blood corpuscles and in the total volume of blood, usually associated with cyanosis and general weakness. This disease was first described by Vaquez in 1892, and Osler, in 1902, gave a more complete study of polycythemia, establishing it as a new clinical entity.

Etiology. The cause of the disease is unknown, but there are a number of theories as to its etiology.

Polycythemia vera occurs more frequently in men than in women, and usually occurs between the ages of thirty-five to fifty-five years. It is an insidious disease, lasting from eight months to ten years, the patient then dying from cerebral hemorrhage or from some intercurrent disease. Bence[7] believes that polycythemia is due to a decreased capacity of the hemoglobin for oxygen. This being primary, an increase in the red cells takes place. This theory is supported by the compensatory polycythemia, which occurs in high altitudes where there is a lack of oxygen and the fact that inhalation of oxygen decreases the red cells. Lommel[8] thinks the primary cause is stasis of the blood. Lefas, Rendu, Widal[10] and others think the disease a primary splenic tuberculosis. Nechanin[11] believes heredity may play some part in the etiology of polycythemia. He tells of a case of a female student with a slight polycythemia, whose mother and sister each had cyanosis and an enlarged spleen. De Chapelle[34] called attention to the history of injury as a cause of polycythemia. Three of Osler's cases laid great stress on some injury, a strain in 2 cases and the kick of a horse in the third. One case reported below had an injury to his neck in early childhood, and Stengel at that time thought that this might have played some part in the cause of the polycythemia.

The immediate causes of polycythemia have been variously ascribed to either a diminished destruction of the red cells, due to an increased resistance of the red cells to the hemolytic amboceptor, as was seen in one case reported by Pichard,[13] or, on the other hand, an increased production of red cells.[6]

Symptoms. Cyanosis, general weakness, enlargement of the spleen, headache and constipation are the prominent symptoms of which the patient complains. In polycythemia the patients are particularly prone to hemorrhages.

* Read before the Pathological Society of Philadelphia, May 26, 1920.

Summary of the Blood Findings. The total amount of blood is increased. This is easily determined by the method of Haldane and Smith.[27]

Red Blood Cells. The number is greatly increased, usually averaging about 8,000,000. In one case reported 14,180,000 red cells were found by J. Hnatek.[28]

Normoblasts. Occasionally normoblasts are found. There may be some anisocytosis and poikilocytosis. The viscosity of the blood is increased in some cases to four or five times the normal.

Leukocytes. They run parallel, with the reds usually. There is a tendency to an increase in the percentage of the polymorphonuclear leukocytes.

Hemoglobin. This is markedly increased but not parallel to the increase of red cells.

Color Index. Less than 1.

Specific Gravity. 1050 to 1065.

The iron, lecithin and phosphoric acid contents of the blood are increased and the salts of the blood are normal.

Blood Serum. This has a low specific gravity, with a low protein content.

In some cases there is associated with the polycythemia a leukemic manifestation. In looking over the literature five cases have been reported in which myelocytes were found in the differential blood examination. Chief among these is the case reported by Blumenthal[2] in which he found the following blood picture: Red cells 11,450,000; white cells, 16,300; Hb., 110 per cent.

The differential count showed 45 per cent. myelocytes.

Pathological Anatomy. In reviewing the cases of polycythemia vera with splenomegaly and cyanosis there are only a few out of the total number reported that have autopsy findings of the bone-marrow included in the reports. Some of these autopsies were evidently carried out carelessly because the observations at the autopsy table were not supplemented by the laboratory examinations of the bone-marrow, spleen, etc.

The pathologic findings in the cases reported do not show any conformity in pathology, excepting the increase of blood in the bloodvessels of all organs. There is a hyperplasia of the erythroblastic and to a slight degree of the leukoblastic tissues of the bone-marrow. Red marrow is found in many places where yellow marrow is normally found. Westenhöpper[15] compares the bone-marrow of polycythemia vera to that of a child. There are an excessive number of eosinophiles and bone-marrow mast cells.

Spleen. The spleen is decidedly increased in size and filled with blood. There is a mild hyperplasia of all the connective-tissue elements, and Hirschfeld[13] found a slight myeloid transformation of the splenic pulp with an increase of the leukocytes and normoblasts. In some cases there are infarcts, in others tuberculosis of

the spleen and in one case of Senator's[6] he found two areas of gummatous masses, although an antemortem blood examination showed the blood Wassermann negative.

Lymph Nodes. There is a lymphadenoid metaplasia, with an increase of the blood in these structures.

Autopsy reports collected from the literature:

Case of Wakasugi, K.[1] Bone-marrow. Medulla of sternum and ribs; dark red. Upper femur: Dark red; lower femur yellow.

Microscopic examination: All cells were found, *i. e.*, myelocytes, nucleated reds, eosinophilic and neutrophilic leukocytes and a few lymphocytes.

Spleen: Normal. No increased phagocytosis.

Conclusion: Hypertrophy of erythroblastic tissue of the bone-marrow.

Case of Rendu and Widal[10] de Moutard, Martin et Lefas:[9] Conclusion: Fibrocaseations; tuberculosis of the spleen.

Case of Cabot, R. C.:[3] Red cells, 10,460,000; leukocytes, 20,000; hemoglobin, 120 per cent.; passive congestion of all organs; nothing clearly seen in the spleen.

Case of Saunby and Russell:[35] Red cells, 9,000,000; spleen enlarged, syphilis thought to be the cause; spleen of normal consistency; heart, hypertrophy of left ventricle.

Case of Türk:[36] Red cells, 7,500,000; hemoglobin, 112 per cent.; congestion of all organs; spleen congested; chronic tumefaction with anemic infarct; kidney, parenchymatous nephritis; apoplectic stroke the cause of death.

Case of Türk:[36] Red cells, 8,024,070; white cells, 26,300; occasional myelocytes; jaundice; enlarged liver, hepatic cirrhosis; enlarged spleen, chronic tumefaction of the spleen; bones, diaphyses uniformly red.

Case of Bauer:[37] Bone-marrow, no alterations; spleen, large; no other changes.

Case of Weber and Watson:[19] Man, aged fifty-eight years: Red cells, 10,000,000 per c.mm.; white cells, 8000 per c.mm.; Specific gravity, 1,066; bone-marrow, hyperplasia of the bone-marrow; red bone-marrow was where yellow marrow is normally found; spleen, tumefaction of the pulp, all organs congested; heart, left ventricle slightly hypertrophied and aortic valves have an old vegetation; some plaques in abdominal aorta; stomach, ulcer on lesser curvature.

Case of Blumenthal:[2] Red cells, 11,450,000; white cells, 16,300; hemoglobin, 110 per cent.; bone-marrow was hypertrophied. There were less fat cells than normal. The bone-marrow was embryonal in type because of the plethora; hypophysis, normal size; absence of chromophilic cells; spleen, enlarged, otherwise negative.

Differential count: Myelocytes, 45 per cent.; young myelocytes, 8 per cent.; specific gravity, 1065.

Treatment. There have been many treatments recommended for this form of polycythemia: venesection, splenectomy, drugs, roentgen therapy and radium. Except in a few isolated cases no permanent cure has been found. Clinicians have been puzzled as to the proper treatment because so little is known of its pathology.

It is the purpose of this paper to give our technic in the treatment of polycythemia by the roentgen rays, and, as far as possible, our reasons for the same. At the present time we can only suggest a method which is based upon the most likely pathologic features, basing it upon what we have thought to be the probable pathology.

There are two questions that confront us: (1) The origin of the disease, and (2) the cause of the splenic enlargement. If we can assume that the disease has its origin in the bone-marrow and the lesion is a primary hyperplasia of the erythroblastic tissues, then our treatment must be of the bone-marrow, with the view of inhibiting the formation of the red cells.

So little is known of the physiology of the spleen that it is difficult to say what is the cause of the splenomegaly. Various writers have attributed the splenomegaly to tuberculosis, syphilis or to a compensatory enlargement. There is some histologic evidence that the spleen destroys erythrocytes by the phagocytic action of the cells of the spleen, and it has been suggested that these cells liberate a ferment or hemolysin which acts extracellularly. Then if the splenomegaly is a compensatory process, attempting to provide for the increased destruction of red cells, our treatment should be with a view of stimulating these functions and not destructive as hitherto used.

The treatment of the bone-marrow in polycythemia vera was first suggested by Stengel in 1907, and at the present time we feel that primarily the bone-marrow should be treated, receiving an inhibitive dose and secondarily the spleen, it receiving a stimulative dose. After we had reached our conclusions on the treatment of polycythemia it was particularly gratifying to find that Krumbhaar,[42] in 1918, suggested that such treatment was the most rational procedure for the treatment of polycythemia vera.

Technic. The details of the technic for the treatment of polycythemia vera is very similar to that outlined by Pancoast[39] for the treatment of leukemia. The only exception is in the treatment of the spleen:

1. The applications are made primarily over the bones of the entire skeleton, except the bones of the head, these being omitted, due to the likelihood of the loss of the hair in this region.

2. Each area is exposed regularly and systematically, and it is recommended that the maximum dose be distributed over three successive days rather than at one time.

3. Exactness in dosage is essential because we do not wish to destroy the bone-marrow, but to inhibit the formation of the red

cells, just as in hyperthyroidism we do not wish to destroy the secreting cells of the thyroid but to inhibit their hyperactivity.

4. Frequency: Daily exposures are advocated until the series is completed. Two areas may be exposed at one time, as in polycythemia we do not get the toxemia we get in leukemia.

5. Direct exposure of the entire spleen is given after the bones of the skeleton have been completed twice, and at this time we only give a stimulative dose.

6. Duration of the treatment depends upon the individual patient. However, three series are usually required before any stability in the blood counts are noticed. After the patient has received three series he should come in at intervals for inspection and blood counts should be taken, so that any premonitory signs, such as increasing red cell counts, can be discovered early.

Comment. This report is in itself preliminary. There are many points that need further investigation: for example, whether there is an increase in hemolysis or a decrease in the formation of the red cells, or both, during roentgen ray therapy of the bone-marrow; does the function of the spleen increase after stimulative doses of the roentgen ray; does the spleen enlarge after stimulative doses of the roentgen ray?

REPORT OF CASE.—This case has been previously mentioned by Pancoast:[33]

W. J. B., male, white, aged forty-two years, weaver. Admitted to University Hospital May 3, 1905. Discharged June 16, 1905.

H. P. I. Patient admitted with history of repeated hemorrhages from bowel, nose and throat, and is in a general weakened condition.

H. P. I. Illness dated back seven years, at which time he began to have pain in the lower abdomen two hours after meals. The pains were paroxysmal and relieved by taking food. For the past two years he has been having hemorrhagic diarrhea, once having as many as twenty-one stools in twenty-four hours. The diarrhea lasts for a few days. One month before admission he had two hemorrhages, one from the nose and the other from the throat, both occurring while he was asleep. Bowels are constipated and the outer portions of the movements are streaked with blood.

S. H., F. H., P. M. H. Negative except injury to the sixth and seventh cervical vertebræ when he was six years of age, at which time the patient was hanged by a rope around his neck, causing a dislocation of the sixth cervical vertebra on the seventh.

Physical Examination. Patient is of raw bony development and poor musculature. His face and hands are cyanosed at times, especially after any excitement. The superficial lymphatic glands are slightly enlarged. Arteries are soft. Pulse not rapid and of fair volume and tension. Fingers stubbed. Head negative. Eyes: Conjunctival vessels injected. Scleræ are rather muddy. Ears and nose: Normal. Mouth: Tongue dark red, otherwise normal.

Neck: Has an angular kyphosis of the sixth and seventh cervical vertebræ. Thorax: small, soft parts poorly developed. Clavicles elevated, giving rather marked fossæ above and below. Respiratory movements are costo-abdominal, the chest being held very rigid, only moving slightly up and down, with very little expansion. Heart outlines: Normal. Lungs: Apices retracted, bases extending to tenth dorsal spine. Diaphragm moves very little on deep inspiration. Percussion shows slight impairment over the right apex. Everywhere else normal. Breath sounds over the right apex show harsh inspiration and prolonged expiration. Elsewhere normal. No rales heard. Dulness begins at sixth rib. Abdomen: Liver palpable half inch below costal margin. Spleen palpable two inches below costal margin. Urine: negative.

SPLENIC AREA TREATED. (W. J. B.)

Year.	Date.	Blood, R. B. C	Year.	Date.	Blood, R. B. C.
1905	May 5	9,110,000	1908	Jan. 4	7,130,000
	W. b. c., 15,360; hb., 110 per cent.; smears of blood could not be made because of the increased viscosity of the blood.			11	7,510,000
				18	7,333,000
				25	7,100,000
				Feb. 2	6,630,000
	May 10	8,880,000		8	8,106,000
	W. b. c., 8800; hb., 100 per cent.			15	6,130,000
	May 18	7,940,000		22	6,590,000
	W. b. c., 10,800			Feb. 29	6,870,000
	May 29	8,260,000		Mar. 8	8,020,000
	W. b. c., 11,200.			14	6,400,000
	June 15	8,450,000		21	7,870,000
	W. b. c., 12,960.			28	6,556,000
	Aug. 5	8,120,000		April 4	7,480,000
	W. b. c., 7,970.			25	7,080,000
	Aug. 14	9,000,000		May 2	7,090,000
	26	8,000,000		9	6,940,000
	Sept. 16	7,950,000		30	7,390,000
	30*	6,800,000		June 13	6,550,000
	Oct. 7	8,200,000		20	7,600,000
	21	8,250,000		27	7,100,000
	Nov. 18	7,600,000		July 11	6,870,000
	27	8,200,000		18	7,660,000
1906	Jan. 1	9,220,000		Aug. 1	6,740,000
	13	8,800,000		8	6,980,000
	27	8,800,000		12	6,600,000
	Feb. 3	8,800,000		Sept. 12	7,320,000
	10	11,000,000		26	7,400,000
	24	9,240,000		Oct. 3	7,020,000
	Mar. 3	8,800,000		10	7,020,000
	10	8,500,000		17	6,300,000
	17	8,240,000		24	6,850,000
	24	8,160,000		31	6,350,000
	April 7	9,030,000		Nov. 7	7,630,000
	28	7,720,000		21	8,037,000
	May 12	7,110,000		Dec. 5	7,150,000
	June 2	8,390,000		12	6,150,000
	9	7,420,000		Dec. 19	7,360,000
	23	9,430,000		29	8,000,000

* The patient up to this time had received 240 milliampère minutes, distance 20 inches, 4-inch spark gap. No filter.

Year.	Date.	Blood, R. D. C.	Year.	Date.	Blood, R. B. C.
1906	W. b. c., 10,320; hb., 135 per ct.		1909	Jan. 16	7,800,000
	June 30	9,080,000		23	8,070,000
	July 7	7,960,000		30	8,300,000
	14	9,150,000		Feb. 6	8,620,000
	Aug. 4	10,200,000		13	7,590,000
	11	8,840,000		20	8,060,000
	18	9,050,000		27	6,760,000
	26	8,530,000		Mar. 3	7,180,000
	Sept. 8	7,650,000		Apr. 10	6,920,000
	15	9,450,000		17	7,320,000
	22	7,710,000		May 1	5,900,000
1907	May 25	8,250,000		8	6,620,000
	Treatment of the bone marrow was started at this time.			13	5,680,000
				22	6,600,000
	June 8	8,125,000		June 19	7,490,000
	15	7,450,000		26	6,720,000
	22	7,900,000		July 3	6,150,000
	29	7,780,000		10	7,080,000
	July 6	8,890,000		17	7,090,000
	20	9,260,000		24	7,460,000
	27	9,508,000		Aug. 14	7,780,000
	Aug. 3	7,230,000		Sept. 18	7,900,000
	17	6,520,000		25	8,040,000
	31	8,500,000		Oct. 2	8,300,000
	Oct. 5	8,200,000		9	7,640,000
	17	7,760,000		16	8,250,000
	Nov. 2	7,620,000		23	9,500,000
	9	7,920,000		Dec. 4	7,930,000
	Dec. 2	7,400,000	1910	Jan. 3	7,920,000
	9	7,730,000		Mar. 28	8,250,000
	30	7,210,000		W. b. c., 8700; hb., 120 per cent.	

Treatment of the splenic area was started soon after this patient came into the hospital. After what was considered a stimulative dose the red count fell from 9,110,000 to 6,800,000 (see Table). Treatment of the spleen was continued until 1907, the red count gradually increasing, reaching as high as 10,200,000 on August 4, 1906. Stengel suggested at this time the advisability of changing the method of treatment, *i. e.*, treating the bone-marrow instead of the spleen. This was done and a more encouraging result was obtained. The red cell count decreased to 5,680,000 and the patient felt much better physically for nearly a year. The blood count did not stay down, however, and the patient gradually returned to his original condition.

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ATYPICAL TUBERCULOSIS WITH MIKULICZ'S SYNDROME: REPORT OF A CASE, WITH UNUSUAL PULMONARY AND SUBCUTANEOUS LESIONS.

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I. Introduction. Tuberculosis of the salivary glands is sufficiently rare to excite interest. It is even more unusual to see it associated with tuberculosis of the lacrimal glands. The case which is here reported showed, besides these unusual localizations, a remarkable pulmonary affection and atypical tumors in the subcutis. The diagnosis, made on clinical evidence, was confirmed by histologic examination of excised tissue.

In 1888 and 1892, Mikulicz[1] called attention to a syndrome of chronic, painless, symmetric enlargement of the lacrimal and salivary glands, with freedom of the overlying skin from inflammatory reaction. Since then a large number of examples of the affection have been reported. In 1909, Campbell Howard[2] collected 67 acceptable cases from the literature and added 4 of his own. Each year three or four more are added, many conforming closely to the original description and many varying widely, including swellings of the lacrimal or salivary glands alone, and even unilateral swelling of a single gland. In spite of attempts to make of "Mikulicz's disease" a pathologic entity by excluding all cases due to ordinary tumor formation, tuberculosis, syphilis, sialodochitis fibrinosa and gout, it is usual at present to consider the affection as a syndrome, very much as are epilepsy and tetany. Accepting this conception, we have no hesitancy in classifying the case herein reported as an example of Mikulicz's syndrome.

II. Case. Mrs. S., a white American housewife, aged twenty-nine years, was admitted to the medical clinic of the University Hospital on June 16, 1920, complaining of tumors in the upper eyelids and about the mouth. Her family history, including that of tuberculosis, is of no interest. She married at twenty-one and her husband and two children are in good health. Her first pregnancy ended in a miscarriage at the fourth month; her other pregnancies terminated in normal deliveries. Her past history is of no interest, except for a submucous resection of the nasal septum in 1913, for itching of the external auditory canal; she was permanently relieved by the operation. Sore-throat and "head colds" have been rare.

[1] Berl. klin. Wchnschr., 1888; Beitr. z. Chir., Festschr., Theodor Billroth, 1892, p. 610.
[2] International Clinics, 19 S., i, 30.

She has had no symptoms at any time referable to the cardiovascular, gastro-intestinal, genito-urinary or neuromuscular systems.

Before the middle of January, 1920, she had been entirely well. At that time a small swelling appeared in the outer half of the upper eyelid on each side. It grew slowly for about a month until it reached the size of a large hazelnut, where it has remained stationary. There was moderate pain during its period of growth, but none since it reached its maximum size. In early March she noticed that it pained her somewhat to chew her food, and a swelling appeared behind the angles of her lower jaw. After a few days this reached its maximum size and the pain disappeared. Shortly

FIG. 1.—Photograph of case.

thereafter a similar swelling appeared on each side, just behind the symphysis of the jaw, and a few days later another pair in the lower side of her tongue, immediately behind the tip. About June 12 she noticed a small, painless tumor in the skin of the anterior surface of the left leg, just below the knee, and another a short distance below her left elbow. In the early part of April she developed a moderate unproductive cough. She states that there was a slight afternoon fever with this, never going above 99.6°. She had no night-sweats, no hemoptysis, no hoarseness and no pleurisy. She was told that she had pulmonary tuberculosis, and was sent to the Michigan Tuberculosis Sanitarium. From there she was sent to the University Hospital.

Examination showed a poorly nourished woman in early adult life. In the outer half of each upper eyelid was an irregular, nodular tumor about the size of a large hazelnut. It was almost cartilaginous in its hardness and was completely without tenderness. There was a partial ptosis of the lids, so that the palpebral fissure was triangular, with the base toward the nose and the pupil partly covered, giving her an appearance that has been aptly compared to

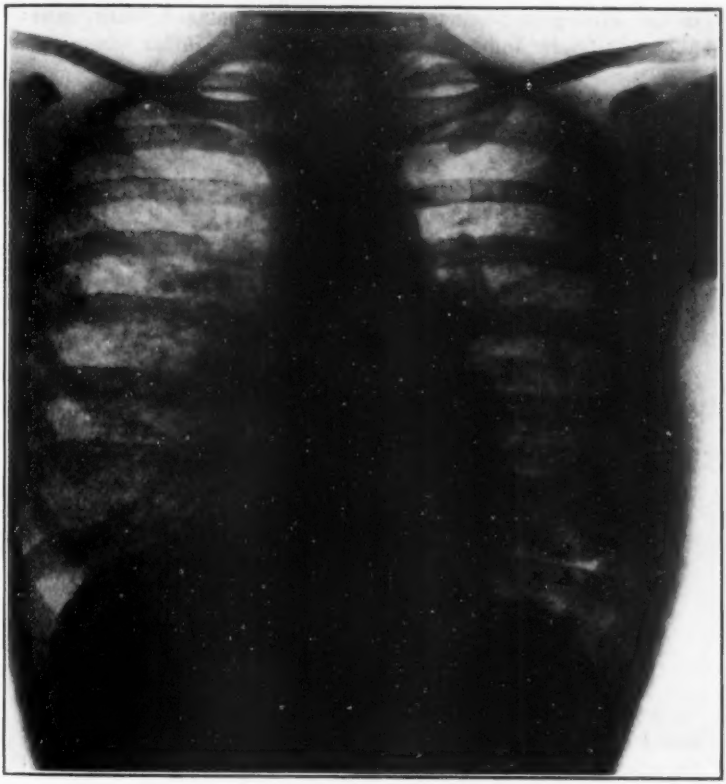

FIG. 2.—Roentgen ray of chest.

that of a blood-hound. The conjunctivæ were normal and there was no gross disturbance of vision. There was a general symmetrical enlargement of the salivary glands. The parotids were as large as small eggs and the submaxillary and sublingual glands were as large as hickory nuts. In the lower lip, near its outer ends, were a pair of glands as large as peas, and there were another pair under the tip of the tongue about the same size. All were extremely hard, and

were entirely non-tender. The mouths of the gland ducts were normal. The thyroid isthmus was firm and easily palpable, about the size of a lead-pencil. The percussion note was impaired over the upper part of both lungs, tactile fremitus and whispered and spoken voice were increased, and there were a few persistent, fine crackling rales; the breath sounds were here of the bronchovesicular type. The spleen could not be felt and there was no general lymph adenopathy. In the subcutaneous tissues of the anterior surface of the left leg just below the knee was a small soft, easily movable, non-tender tumor the size of a pea. A similar tumor was

FIG. 3.—Photomicrograph of a piece of salivary gland from lower lip.

found over the left ulna, just below the elbow. As was true of the glands, the skin over these tumors was not apparently involved in the process.

She was referred to the otological and ophthalmological clinics, both of whom stated that their special examinations revealed no pathology except that described above. Two roentgen-ray exposures were made of the chest. The plates were not characteristic of pulmonary tuberculosis, and from them the diagnosis could not be carried further than that there was "some sort of interstitial sclerosis." The roentgenologist believed that the picture could easily have been caused by the tubercle bacillus. Tangential expos-

ures of the face failed to show any shadows suggesting calcification in the enlarged glands.

The urine was at all times normal and the blood-pressure was 120 systolic and 70 diastolic. No sputum was obtained, even after the administration of potassium iodide. Wassermann's reaction on the blood was negative. Repeated examinations showed the blood entirely normal. The hemoglobin was always between 85 per cent. and 95 per cent. on the Talquist scale, the red cells were between 4,600,000 and 4,830,000 and the leukocytes between 4600 and 7650. Stained smears of the blood showed no abnormalities

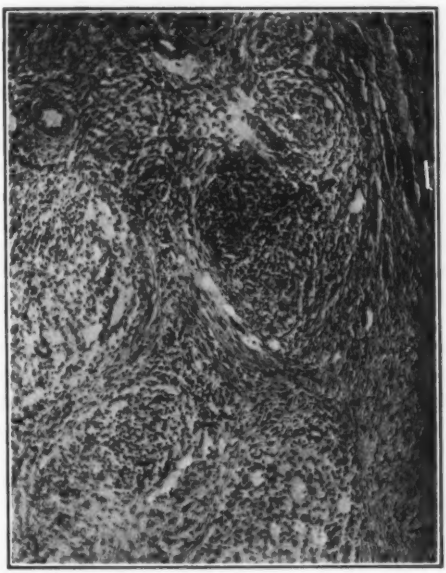

FIG. 4.—Photomicrograph of piece of subcutaneous tumor.

and the differential counts were all normal. One-tenth of a milligram of Koch's old tuberculin, injected subcutaneously into the arm, produced a definite febrile reaction, though she had had no fever before. A half a milligram, injected after the patient had been afebrile for a week, produced a typical fever, with subjective symptoms of malaise.

During her stay in the hospital her temperature and her pulse and respiratory rates remained normal. The enlarged glands showed a striking tendency to resolve, and by July 15 the submaxillary and sublingual glands were not palpable and the parotids had decreased noticeably in size. The subcutaneous tumors increased

in number, though not in size, until on July 15 it was noted that there were a dozen or more on each arm and leg. There was no apparent grouping of them, and all were about the size of peas. They were in the subcutaneous tissues, freely movable and free from tenderness. The skin over them was not changed. The tumors resembled more than anything else the tumors of multiple fibromata of the skin. When the patient left the hospital on July 20 she agreed with us that there had been further diminution in the size of the parotid swelling, though her only treatment had been rest, a high caloric diet and, empirically, syrup of iron iodide. The lacrimal glands appeared no different from their condition at entrance.

One of the enlarged accessory salivary glands was removed from her lip, and a subcutaneous tumor from her lower arm and examined microscopically by Dr. A. S. Warthin. The report from the department of pathology is as follows:

Salivary Gland. "Description: The specimen consists of a mucous salivary gland and a small lymphoid node. Throughout the gland there are numerous miliary tubercles, consisting of sharply circumscribed avascular epithelioid nodules, containing many characteristic giant cells. These miliary tubercles occupy the rudimentary lymphoid nodes of the gland. In a number of areas around the larger ducts they are conglomerated into larger masses of epithelioid tubercles. These tubercles show almost no tendency to caseate. The epithelioid areas themselves are completely devoid of bloodvessels, although in the agglomerated nodules, remains of capillaries can be found at the borders, and between the miliary tubercles there is a slight lymphocyte and plasma cell reaction about the tubercles. The picture is that of an avirulent non-caseating tuberculosis seen in some cases presenting the clinical picture of Hodgkin's disease, in which there is a systemic involvement of all the lymph nodes. As a rule it is very difficult to demonstrate tubercle bacilli in these by staining. From the appearance here I believe that this is an avirulent form of tuberculosis, probably bovine and similar to that found in some cases of generalized tuberculosis of the lymph nodes, as mentioned above."

Subcutaneous Tumor. "Subcutaneous tissue. This is apparently a hyperplastic rudimentary lymph node surrounded by striped muscle. It is very edematous, probably from an injection of a local anesthetic. It consists of centers of avascular epithelioid miliary tubercles, encapsulated by fibroblastic and mature connective tissue. About this there is a very marked inflammatory reaction with new bloodvessel formation and polynuclear and mononuclear infiltrations, a secondary infection or inflammatory reaction, due to some other cause. The appearance of the miliary tubercles here is spoiled more or less by poor preparation and the edema, but the same non-caseating avascular epithelioid nodules are shown, but with few giant cells."

III. Diagnosis. The clinical evidence, combined with the histologic examination of the extirpated tumors, puts the diagnosis of tuberculosis beyond doubt. Had any one of the lesions—the pulmonary fibrosis, the tumor of any one gland or pair of glands, or especially the subcutaneous granulomata—been presented alone there would have been more than a little difficulty in running down the etiology. The occurrence of all this remarkable pathology in one patient is of great interest as a suggestion of the bizarre ways in which the tubercle bacillus may make known its presence.

May we reasonably add this to the group of cases which have been collected under the name of Mikulicz's syndrome? This opens the argument as to whether or not the name of the German surgeon should be applied only to those cases in which the glandular swellings are lymphomatous, or to all cases of chronic painless, symmetric swelling of the lacrimal and salivary glands.

Clinically, without biopsy, the tumors about the face were in every way typical of the so-called "true Mikulicz's disease." They were symmetric, chronic and painless. The lacrimal glands were first involved, then the parotids and finally the accessory salivary glands, even those on the tip of the tongue, which are so characteristic of the affection. Their hardness to palpation is a feature that has attracted the attention of most observers. Finally, complete agreement is reached in the tendency to spontaneous involution.

Among the hundred or more cases which have been reported under the name Mikulicz's syndrome have been examples of several systemic diseases. Many, of course, were part of a leukemia, and these together with those which are apparently lymphomata with no systemic disease are the cases to which some authors, notably Howard,[2] have attempted to restrict the name. Three cases of undoubted tuberculosis have been reported (vide infra). Several have been found in luetics, as, for example, the cases of de Massary and Tockman[3] and Gutmann.[4] Deglos[5] has reported an example of the syndrome in a woman of sixty-four with gout. In another interesting group of cases the salivary glands have been enlarged since birth, with similar tumors among other members of the same families (Quinke,[6] Leri,[7] and Fontoynont[8]). It is also of interest to note that a bilateral swelling of the salivary glands occurs intermittently, with complete subsidence between attacks in a condition which has been called sialodochitis fibrinosa; one of the early cases, that of Battle,[9] seems to have belonged to this group.

[2] Bull. et mém. Soc. méd. d. hôp. de Paris, 1918, 3 S., xiii, 627.
[4] Berl. klin. Wchnschr., 1907, xliv, 1141.
[5] Presse méd., Paris, 1912, xx, 125.
[6] München. med. Wchnschr., 1906, liii, 1, 1213.
[7] Bull. et mém. Soc. méd. d. hôp. de Paris, 1912, xxxviii, 562.
[8] Presse méd., Paris, 1911, xix, 455.
[9] Tr. Clin. Soc., London, 1895, xciii, 282.

Thursfield,[10] in a very exhaustive clinical review, classifies the cases reported as follows:

1. A cogenital, hereditary or familial affection.
2. "Mikulicz's disease proper."
3. Mikulicz's disease, with involvement of the lymphatic apparatus.
4. Leukemia.
5. Tuberculosis.
6. Syphilis.
7. Gout.
8. Sialodochitis fibrinosa.

A glance at such a classification shows that one author, at least, allows considerable latitude in the limits which the term may include. We are certainly with the majority of writers in giving the syndrome sufficient breadth to admit such a case as this.

IV. Mikulicz's Disease and Tuberculosis. I have been able to find only three cases of Mikulicz's disease that were undoubtedly tuberculous.

Plitt's case,[15] one of the *formes frustes*, was that of a young man with the parotids only involved. He gave a history of tuberculosis earlier in life, the tuberculin reaction was positive and tubercle bacilli were found in the gland. Krailsheimer[13] observed a case with the characteristic bilateral swelling of the salivary and lacrimal glands in whom there was a "catarrhal pulmonary affection;" the tuberculin reaction was positive and the microscopic examination of the extirpated glands was strongly suggestive of tuberculosis. The diagnosis was confirmed by the development of a bilateral typically tuberculous iridocyclitis. The process healed under therapy with new tuberculin. Napp[14] described a case of undoubted tuberculosis of the salivary and lacrimal glands, with miliary tubercles in the oral and conjunctival mucosæ. Some of the tubercles caseated, and the bacilli were found in the extirpated gland. There was mentioned in his report some pathology of the left pulmonary apex.

In all three of these cases the clinical picture was in harmony with the diagnosis of tuberculosis as made by the microscope. In each case there were some points suggestive of tuberculosis, and at least one which clinched the diagnosis. There are besides these undoubted cases a few more in which a tuberculous etiology is more or less strongly suggested. The patient reported by Osler[15] for instance, had, besides the enlargement of the lacrimal and salivary glands,

[10] Quart. Jour. Med., 1913, vii, 237.
[11] von Brunn: Beitr. z. klin. Chir., Tübingen, 1905, xiv, 225.
[13] Beilageheft d. klin. Monatsblat. f. Augenheilk., 1905, xiii, 2, 40.
[13] Ophth. Klinik, 1907, p. 15.
[14] Ztschr. f. Augenheilk., 1907, xvii, 513.
[15] Am. Jour. Med. Sc., vol. cxv, p. 1893.

pulmonary tuberculosis; however, she had also a rhinitis which was regarded as luetic. In Pick's case,[16] though there was also a bilateral apical tuberculosis with acid-fast bacilli in the sputum, the author was convinced that the microscopic pathology was not that of tuberculosis. Igersheimer and Poellot[17] discuss the various reported cases, and conclude that though tuberculosis does occasionally cause the syndrome of Mikulicz it is an unusual etiology of the condition and that the majority of cases have nothing to do with tuberculosis.

It is to this group of cases that the one herein reported belongs. To attempt to defend the thesis that any large proportion of the cases of Mikulicz's syndrome is atypical tuberculosis would, in the light of our present information on the whole subject, be absurd. It is an interesting possibility, however.

V. Mikulicz's Syndrome and Skin Lesions. Two cases of Mikulicz's disease with cutaneous manifestations have been reported. Neither case was tuberculous. The clinical description of the skin infiltrations and the histologic examination of the extirpated tissue did not suggest it in either case under discussion.

Hackel's patient[18] had enlargement of the lacrimal, parotid and submaxillary glands. He came to autopsy as the result of an ulcerative enteritis. Scattered over the head and back were painful cutaneous tumors the size of beans, with a feeling of tension and heat, and tender to pressure. On the breast were many firm, reddish wheals. There were a few more of these on the back and abdomen. Histologically the skin showed a round-cell infiltration around the sebaceous glands. There was some newformed connective tissue around these islands. The skin infiltrations, the great enlargement of the spleen, the fever, the course of the disease and the histology of the tissues make it seem probable that this was an example of aleukemic leukemia.

Plate and Lewandowsky[19] reported a remarkable case in a twelve-year-old boy, who developed during excellent health painless swellings of the parotid, submaxillary and sublingual glands. The axillary, cervical and inguinal glands were found enlarged and the spleen was palpable. An exanthem appeared on the inner and anterior surfaces of both legs, consisting of many round, illy-defined, painless lesions. They were about the size of a mark, light red in color and slightly elevated. The eruption had the localization, appearance and course of an erythema nodosum. It went through the usual color changes, gradually fading; new lesions appeared and went through the same process, always confined to the legs

[16] Zentralbl. f. Augenheilk., 1896, xx, 97.
[17] Arch. f. Ophthal. v. Graefe, 1910, lxxiv, 411.
[18] Hackel; Arch. f. Chirurgie, 1903, lxix, 1910.
[19] Plate and Lewandowsky; Mitt. aus d. Grenzgeb. d. Med. u. Chir., 1912, xxv, 539.

NOTE.—Extended bibliographies will be found in 2, 10, 11 and 17.

below the knees, except on one occasion, when there were a few lesions on the buttocks. After six months he began to improve and in another half-year had entirely recovered. The authors regard it as a case of chronic infection by an unknown organism. Wassermann and von Pirquet reactions were negative. Examination of a piece of skin from the leg showed a chronic inflammatory reaction, fibroblasts predominating. The infiltration followed the vessels, and was greatest in the vascular regions near the follicles and sweat-glands, being confined to the cutis and subcutis. There were a few epithelioid cells and a few polynuclear cells, though no real giant cells. Tubercle bacilli could not be found.

That these two cases do not suggest in any way the one herein reported is obvious and the three cannot be grouped together except as cases of Mikulicz's syndrome with skin lesions. Our case is the only one of the three in which we can say definitely what these lesions are.

VI. Summary. 1. An unusual case of tuberculosis is presented, in which there is a typical clinical picture of Mikulicz's syndrome associated with atypical pulmonary and cutaneous lesions. Histologic examination of a salivary gland and of a subcutaneous tumor reveals undoubted miliary tubercles.

2. Search of the literature reveals only three other cases of the syndrome which are beyond question tuberculous, and only two other cases with skin manifestations, neither of which resembles this one.

In conclusion, I wish to thank Dr. L. H. Newburgh for his kind and valuable suggestions in the study of the case and the preparation of this report.

SYPHILIS OF THE TRACHEA AND BRONCHI: A RESUME OF THE DIAGNOSTIC FEATURES, WITH THREE CASE REPORTS.

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When syphilitic lesions occur in the trachea and bronchi the resulting clinical picture, though somewhat variable, usually has certain definite features so characteristic that the diagnosis can be made by means of a careful study of the history and the physical examination of the patient without laboratory assistance. The purpose of this paper is (1) to state briefly what these characteristic features are, and (2) to present the case reports of two cases seen within four months of each other on the service of Dr. L. A. Conner, the first medical division of the New York Hospital, and also an abstract from the record of a third case on the same division three years before.

Conner's monograph[1] on this subject (1903) has remained authoritative. He divides the syphilitic lesions of the trachea and bronchi into four main types:

1. Gummatous swellings—circumscribed or diffuse.
2. Ulcers—single or multiple and with all possible variations.
3. Endotracheal connective-tissue new growth:
   (*a*) Distinct scars.
   (*b*) Diffuse thickening.
4. Fibrous peritracheitis, *i. e.*, masses of dense fibrous tissue developing outside the cartilaginous rings.

Associated lesions are those of syphilis in the larynx and higher air passages, and in the lungs, those of the various pneumonias, dilatation of the trachea and bronchi, etc.

The affection is commonest in the fourth decade and is slightly more frequent among men than among women. The duration of the syphilitic infection varies enormously, that is, from nine months to forty-two years. The lesions may be due to congenital syphilis. The rarity of the occurrence of syphilitic lesions in the trachea and bronchi is shown by Symmers[2] in his report on the syphilitic lesions found in 4880 necropsies. Although there was anatomic confirmation of the existence of syphilis in 314 cases, or 6.5 per cent., Symmers found syphilitic lesions of the trachea in only 4 cases, that is, in slightly over 1 per cent. of the syphilitic cases and in less than 1 in 1000 of all cases. He does not report finding syphilitic lesions in the bronchi. On the other hand, C. Jackson[3] has written that of the specific inflammations that may cause tracheal stenosis, viz., syphilis, tuberculosis, glanders, typhoid fever and diphtheria, syphilis is by far the most frequent cause, in first its edematous stage and later in its cicatricial stage. And Howard[4] has said in a discussion of bronchiectasis that the possibility of syphilitic stenosis must always be excluded as an etiologic factor. In any case the diagnosis is important because of the gravity of the symptoms and the likelihood of cure by appropriate treatment, for without such treatment the prognosis is quite bad, over half of Conner's series of collected cases being fatal.

Symptomatology. The stages are commonly those of tracheal or bronchial obstruction. Gerhardt[5] noted three stages:

[1] L. A. Conner: Syphilis of the Trachea and Bronchi, Am Jour. Med. Sc., July, 1903, cxxv, 57.

[2] Anatomic Lesions in Late Acquired Syphilis, Jour. Am. Med. Assn., May, 6, 1916, lxvi, 1457.

[3] Tracheobronchoscopy, Esophagoscopy and Gastroscopy, p. 43. Pub. by The Laryngoscope Co., St. Louis, Mo., 1907.

[4] C. P. Howard: The Etiology and Pathogenesis of Bronchiectasis, Am. Jour. Med. Sc., March, 1914, cxlvii, 313.

[5] Gerhardt: Quoted by Conner, Deutsch. Arch. f. klin. Med., 1867, Bd. ii, 535. Also Osler and Gibson: Syphilis of the Trachea and Bronchi, in Section on Visceral Syphilis, System of Syphilis, Oxford Med. Pubs., 1914, iii, 7. S. Israel: Syphilis of the Tracheobronchial Tree; Case of Gumma of Trachea, Texas State Jour. of Med., February, 1920, xv, 362; also abstr. in Jour. Am. Med. Assn., March 13, 1920, lxxiv, 765.

1. Stage of irritation.
2. Stage of permanent stenosis.
3. Stage of suffocating attacks.

As to the earliest symptom, cough is often the first, indicating the stage of irritation, that is before obstruction comes on. Sometimes dyspnea has been the first symptom or the two have appeared together. Quite usually the history is of less than one year's duration.

Of individual symptoms, cough is a prominent one, as well as often the earliest, and though quite variable it usually has a brassy, ringing quality similar to that heard with compression or irritation of the trachea in cases of aneurysm of the arch of the aorta. This quality is characteristic and is of importance in the diagnosis. The sputum is variable in amount and character. Hemorrhage once in a while is profuse, but more frequently only sufficient blood is raised to streak the sputum. Of all the symptoms, dyspnea is perhaps the most constant and most conspicuous, usually beginning early and increasing in severity to occupy the foreground of an extremely alarming and distressing clinical picture. It appears in two distinct forms: a constant dyspnea and paroxysms. The constant dyspnea is continuous and progressive, indicating the stage of permanent stenosis. The paroxysmal form is characterized by superimposed attacks of alarming air hunger, with orthopnea; cyanosis; stridor; inspiratory sinking-in of the tissues of the neck and epigastrium; rapid, feeble pulse and sometimes even unconsciousness. This form, demarking the stage of suffocative attacks, occurs in about half the cases, and death may occur during such an attack. Stridor is a very conspicuous and striking symptom. It may occur during either inspiration alone or expiration alone, or during both. Its character and intensity are quite variable in different cases. Pain is not often a conspicuous symptom, and, when present, does not by its location assist materially in locating the lesion. Tenderness is mentioned in descriptions of tracheobronchial syphilis but is relatively unimportant. The voice, even with an apparently normal larynx, may assume almost any abnormal character or even disappear. A marked limitation in the vertical mobility of the larynx during respiration is considered of considerable diagnostic importance, particularly in differentiating tracheal stenosis from laryngeal stenosis. Lung signs and conditions are very variable and are often concealed by the stridor or by tracheal rhonchi.

The diagnostic difficulties vary according as to whether there are or are not signs of obstruction to breathing. If there are not the diagnosis is usually made by actually seeing the lesion as in a bronchoscopic examination and by blood Wassermann tests, etc., the symptoms—cough, pain, sputum, etc.—being common to various pulmonary conditions. But obstruction in the larger air passages usually gives a characteristic and unmistakable clinical picture, the features of this being (1) a peculiar type of dyspneic breathing, in

which the prolonged, labored and relatively slow inspiration and the shorter easy expiration follow each other without the usual pauses; (2) a stridulous sound chiefly or altogether inspiratory; (3) a characteristic hard, brassy cough, often paroxysmal; (4) in most cases an inspiratory sinking-in of the tissues of the root of the neck, the epigastrium and the lower intercostal spaces. Laryngeal examination will rule out laryngeal obstruction, but if such an examination is impossible for some reason or other, points that may help in differentiating laryngeal from tracheal or bronchial obstruction may be obtained from a careful study of the history, the character of the voice, the amount of respiratory movement of the larynx, the location of the inspiratory thrill and the point of greatest intensity of the stridor, and possible variation in the signs over the two sides of the chest.

Non-syphilitic causes of tracheobronchial stenosis must be ruled out if possible. Of the non-luetic conditions causing compression of the trachea or bronchi from without, one must consider goiter, enlarged lymph glands, as in tuberculosis or in Hodgkin's disease, thoracic aneurysm, neoplasms, etc. Possible factors operating from within to cause obstruction include foreign bodies, simple and malignant new growths and other, very rare, conditions.

The reports of the three cases follow:

Case I.—H. W., female, aged thirty years, single, no occupation, was admitted December 10, 1915, the chief complaints on admission being of paroxysmal attacks of coughing, with suffocating dyspnea and a "rapid heart."

History. The family history was irrelevant and showed nothing to indicate the presence of congenital lues. The patient had had diphtheria at five and so-called "rheumatism" at eight, but otherwise had never been ill before and had had no previous illnesses like the present trouble. She was accustomed to six to eight alcoholic drinks a day.

Present Illness. Paroxysmal attacks of coughing started three and a half months prior to admission and continued, with increasing severity, up to the time of admission. At first the attacks came on only in the early morning, and after coughing and vomiting the patient would feel well for the rest of the day. This condition lasted about three weeks and then for two weeks stopped practically entirely; but then the attacks became much more severe, so that for the five or six weeks before admission she coughed all day and seemed unable to get her breath, "occasionally becoming somewhat blue in the face." Six days before admission the cough became even more severe and more paroxysmal in character, the breathing more labored and her face markedly cyanotic. This condition persisted up to the time of her admission. There were no chills nor headaches.

Her average weight had been 138 pounds, but at the time of admission she weighed only 110 pounds.

Physical Examination on Admission. The patient is a fairly well-nourished, white woman, aged thirty years, sitting propped up in bed, apparently acutely ill. Respirations are increased in rate (about thirty-eight per minute) and markedly stridulous in character, the stridor being "so near the ear as almost to make it seem to have come from the larynx," and there are loud asthmatic wheezes to be heard. Occasionally the patient is seized with a paroxysm of violent coughing, the cough being distinctly brassy and ringing in character. During these paroxysms she becomes very markedly cyanotic, but even in the intervals she is continually quite cyanotic. The respiratory effort is great, both on inspiration and expiration.

Head. The pupils are moderate in size, regular, equal and active; the ocular movements are normal. The lips are cyanotic. The teeth are in good condition, but with a small focus of pyorrhea. The tongue is moist and considerably coated. The tonsils and pharynx are negative. There are no ulcerations on the mucous membranes.

The lymph glands are small; the epitrochlears are not palpable. The neck reveals no rigidity nor abnormal masses; there was no thyroid enlargement.

The chest is symmetrical and well formed. The respiratory movement on the left side is definitely less than that on the right. The percussion note is normal throughout the lungs, with slight dulness over the right apex, the change, however, being well within the limits of normal. There are loud and wheezy, sonorous and sibilant rales, typically asthmatic in character, throughout both lungs; but the transmission of these rales or rhonchi and of the vesicular element of the breath sounds is distinctly less to the left side than it is to the right. The voice sounds seem alike on the two sides. There is no palpable cardiac impulse. The area of dulness extends from 8.5 cm. out in the fifth left interspace to the right border of the sternum. The heart sounds are markedly obscured but apparently normal in character. The *pulses* are moderate in volume and tension; regular in force and rhythm, and alike in the two wrists.

The abdomen reveals no tenderness, no masses nor rigidity. There are normal limits to the liver dulness and the liver edge is not felt. There are no scars, edema nor tenderness along the tibiæ. A fine tremor is present in the fingers of the outstretched hands. The knee-jerks are normal. The abdominal reflexes are absent.

Summary. There is marked stridulous, wheezy respiration, with paroxysms of brassy coughing, and marked cyanosis. The respiratory movement is greater on the right side than on the left. The transmission of asthmatic rhonchi and of the breath sounds is greater to the right side than to the left. No luetic stigmata are found.

Course in Hospital. (Excerpt from discharge note).

"On admission she presented a greatly weakened condition, with marked difficulty in stridulous breathing. Examination of the chest was negative except for lessened respiratory movement on the left side and poorer transmission of breath sounds on that side. Laryngeal obstruction was ruled out by examination. In the absence of all signs of aneurysm or of mediastinal growth, a diagnosis of lues of the left bronchus, with obstruction, was made by Dr. Conner and an immediate blood Wassermann taken; however, because of the urgency of the symptoms, the patient was given mercury without waiting for the result of the Wassermann. That, however, was found to be positive a few hours later, and on the next day (second day in the hospital) she received 0.3 gm. of salvarsan; her symptoms on this day were much relieved, though she began to express delusional ideas, which were considered part of an exhaustive psychosis. Her temperature had fallen and her pulse had become slower and of much better quality. However, on the following day (the twelfth) she developed a high fever; and on the second day of the same, signs of consolidation were found over the right lower lobe. From that time on she lost strength and died from exhaustion December 17, 1915, at 1 A.M., without the breathing at any time returning to the character it had on admission."

SPECIAL EXAMINATIONS.

Blood counts.	On admission, Dec. 10, 1915.	Dec. 15, 1915.
White blood cells	15,000	29,000
Hemoglobin (Sahli)	.....	90 per cent.
Polymorphonuclears	82 per cent.	85 "
Small lymphocytes	13 "	8 "
Large mononuclears	3 "	2 "
Transitionals	2 "	5 "

Wassermann (blood), December 10, 1915, ++++ (maximum).

Urine analyses, essentially negative.

Blood-pressure, on admission, right arm: systolic, 120; diastolic, 80; left arm: systolic, 115; diastolic, 80.

Autopsy. December 17, 1915 (Dr. Elser), eleven hours post mortem: Abstract from the report.

Diagnoses:—Syphilis.

(Gumma of bronchial and mediastinal lymph nodes).

(Gumma of liver, Hepar Lobatum).

Stenosis of left bronchus (partial obstruction).

(Stenosis of left branch of pulmonary artery).

Chronic parenchymatous nephritis.

Lobar pneumonia.

Inspection. Body small but otherwise fairly well developed and fairly well-nourished female. An external examination reveals no evidences of syphilis.

Pleura. Pleura free from adhesions. The visceral layer of the pleura over the lower lobe on both sides is covered with a recent fibrinous exudate.

Thymus. The thymus is absent. The mediastinum is definitely fuller than usual and the contained structures are firmer.

Pericardium. Pericardium smooth and glistening throughout. Contains about 20 c.c. of clear serous fluid.

Heart. The heart is normal in size. The left chambers contain a small amount of clotted blood. The right chambers are filled with a chicken clot and are normal in size. The valves are normal throughout (no evidences of relative insufficiency on the right side). Myocardium is grayish pink in color, opaque in appearance and rather flabby in consistence. No focal lesions. The pulmonary artery was opened and the finger passed up into the two branches of this vessel. The right branch of this vessel permitted the passage of the index finger, while the finger passed into the left branch meets with a definite constriction at a point corresponding to the entrance of this vessel into the lung. At this point the vessel permits the entrance of the tip of the little finger only and the posterior wall of the vessel on the cardiac side of the constriction is puckered, suggesting that the stenosis is due to the contraction of tissues situated behind this vessel.

The lungs, heart, mediastinal structures, trachea, larynx and tongue were removed intact and the subsequent dissection reveals the following:

The faucial and lingual tonsils were normal. The tongue showed no evidences of syphilis. The median glosso-epiglottidean ligament is slightly thickened and retracted, causing a more marked anterior curvature of the epiglottis than is usual (syphilis?). The larynx and trachea apart from congestion of the mucosa present nothing unusual. Thyroid is normal in size and appearance. The deep cervical nodes are moderately swollen and congested. The nodes along the trachea as it enters the thorax are also moderately enlarged and some of them definitely indurated. Cut section of one of these nodes shows that it is partly replaced by a nodule having the typical appearances and consistency (elastic) of a gumma. The superficial mediastinal nodes are swollen and congested; the deeper nodes at the bifurcation of the trachea and at the hilum of both lungs are enlarged and indurated. A dissection of these nodes was not made (specimen preserved for museum purposes). The right bronchus and its main branches were opened by an incision along the posterior wall. On the anterior wall of the right bronchus just below the point of bifurcation of the trachea an irregularly circular defect about 1 cm. in diameter was found. The margins of this ulcer showed a thin gray slough while the base was formed by an indurated and anthracotic lymph node. The wall of the left bronchus showed an extensive irregular defect involving the lower surface of this tube. Projecting

through this opening into the lumen of the bronchus there was a soft node about the size of a small lima bean. This body was evidently responsible for the symptoms of stenosis observed during the life of the patient. The margins of this ulcer were ragged and covered by a thin gray slough. The bronchial mucosa was deeply congested throughout. Transection of one of the larger indurated bronchial nodes showed that it was completely replaced by a gummatous growth which because of the edema of the tissues had lost some of its characteristic features (appearance and consistency).

Lungs. The lower lobes on both sides with the exception of the apices and a few areas in the lowermost portions of these lobes were consolidated. Cut section shows the typical uniformly granular gray and reddish gray appearances of a frank lobar pneumonia. The uninvolved portions of the lower lobes and the upper lobes (including the middle lobe) were edematous and congested.

Liver. Liver larger than normal. Weight, 3 pounds 14 ounces. The upper surface of the right lobe is covered by adhesions. The right lobe shows a number of deep scars dividing this portion of the organ up into a number of smaller lobes (hepar lobatum). Cut section of these scars reveals gummatous deposits. The liver as a whole shows a moderate grade of congestion with a high grade of fatty infiltration. No microscopic evidences of a diffuse cirrhosis.

Gastro-intestinal Tract. Esophagus normal. Stomach normal in size. The remainder of the intestinal tract presents nothing unusual. Solitary and agminated follicles normal. Appendix normal. Mesenteric nodes present nothing unusual.

Aorta. Normal throughout.

Microscopic Examination. The lymph nodes show the lesions of a gumma.

CASE II.—A. J. C., male, aged forty years, married, a salesman, was referred by Dr. Josph L. Frey, and admitted March 28, 1916, complaining of a paroxysmal cough and noisy, difficult breathing of about three years' duration.

History. The family history was unimportant and gave no indication of congenital lues. The patient had pleurisy without effusion in the right chest seven years before admission, and has had occasional "colds." Two years before admission, following ten to fifteen years of difficulty in breathing through his nose, he had a nasal polyp removed from the right side and was relieved. Section and study of the tissue removed was not done. As a salesman he has had to do much talking, and at times has had a husky voice and sore-throat in consequence. He admits two Neisser infections but denies luetic infection by name and symptom. A first wife's only two pregnancies ended in stillbirths, but a second wife has had three normal pregnancies only. He occasionally drinks three or four whiskys a day, but frequently none at all.

Present Illness. The first symptom noticed was about three years before admission, when the patient noticed the gradual onset of an occasional cough. At first the cough was harsh and tearing in character and practically unproductive. Later it seemed to him to sound "hollower." He was usually freer from the cough during the summer months, but during the winters the cough became progressively worse and was most severe about ten days before admission. Even during the winter months, however, he occasionally had short periods in which he was comparatively free from the cough, and during the week before admission he was better than during the week before that. Occasionally with the cough he would have a great deal of difficulty with breathing, and about eight times during the past twelve months he has had paroxysms of coughing so severe as to be terminated by syncope for a brief time, even falling off a chair and completely "losing his bearings." His friends have told him that he would become red at these times but not particularly blue. These paroxysms occurred at no particular hour and without apparent cause or exciting factor.

Five or six months after the cough began the patient began to have a good deal of dyspnea on exertion, but not usually when sitting still, except on wet days. This was considered to be asthma by a doctor. Also, for the past two years, he has been unable to sleep in a horizontal position because of the cough. For two years he has been able to hear himself breathe, both during inspiration and expiration, and friends have commented on it for a year.

He has had some expectoration for two and a half years, but especially for the past year. The amount of sputum has varied from none after much coughing to a mouthful. There has been no profuse expectoration on arising in the morning. The sputum has usually been a yellowish-white mucus, occasionally streaked with blood, and with no particularly offensive odor and no hemorrhage as such. During the past two or three months he has frequently felt as though there was some sticky adherent mucus in his trachea, because at these times he would breathe with difficulty and in an unusually noisy and wheezing manner, and on these occasions he would expectorate rather profusely.

He has had no chest pains at any time, but occasionally has a sensation of compression. He has had no headaches and has not slept well because of the coughing.

Physical Examination on Admission. The patient is a muscular, well-nourished man, aged forty years, lying comfortably in bed and does not appear to be acutely ill. There is no cyanosis. A moderate cough is present, characterized by a peculiar deep barking sound and productive of a rather considerable amount of whitish sputum showing a few pink streaks.

The pupils are equal, regular and react to light and accommodation. The pharynx shows a mild chronic pharyngitis, but there

are no evidences of palatal paralysis nor signs of any growth, nor are there any scars nor mucous patches. The cervical veins are not engorged and no abnormal pulsations are made out in the neck.

The chest is symmetrical, large and muscular. Respirations are slightly increased in rate and inspiration and expiration are apparently of equal length. During both the breath sounds are audible as coarse, moist sounds, apparently in the throat. Expansion is good and apparently equal on the two sides. In the left chest anteriorly the wheeze of the breath sounds is distinctly palpable during both inspiration and expiration. This is also true in the left chest posteriorly and to a lesser extent in the right chest posteriorly but it is not felt in the right chest anteriorly. Tactile fremitus is apparently equally transmitted throughout both lungs. Resonance is slightly decreased throughout both lungs, probably due to the thickness of the chest wall and the muscular development. No special areas of dulness or hyperresonance are made out. In the left chest anteriorly the breath sounds are entirely obscured by coarse, squeaking, loud rhonchi, which are of equal length in inspiration and expiration and which are also similarly heard in the left chest posteriorly. In the right lung anteriorly the breath sounds can be made out as vesicular and well transmitted, but moderately obscured by similar rhonchi of lesser intensity and loudness; so also in the right chest posteriorly. No rales are heard. Whispered and spoken voice sounds are equally and moderately well transmitted throughout both lungs.

Heart. There is very little if any palpable impulse and the apex beat is not localized. The area of relative cardiac dulness lies entirely between the sternum and 10 cm. out in the fourth left interspace and the area of absolute dulness is quite small. The heart action is rather slow and regular. The second pulmonic sound is not augmented. The sounds are of good quality and no murmurs are heard.

The abdomen is negative. The liver dulness extends from the upper border of the fifth rib to the costal margin. The lymph glands are not enlarged; the epitrochlears are not palpable. The external genitalia are normal. The extremities are normal; the knee-jerks are equal and active. The skin is smooth and moist; normal in color; and no scars or eruptions are present. There are no enlarged or prominent veins on the chest.

Course in Hospital. March 28, 1916, admitted. Temperature, 100.8°; pulse, 112; respirations, 24; blood-pressure, 120.

Examination of larynx by Dr. Erskine:

"Epiglottis V-shaped. Signs of a mild chronic laryngitis; viz., cords slightly pink and slightly thicker at the free edge than normal. No paralysis. No signs of any growth. No scars in pharynx. No mucous patches seen."

Wassermann (blood): "Must go in the doubtful class. Circumstances required performance of the test by the incubation method and a repeat Wassermann was asked for."

March 29. *Roentgen ray:* Site examined, chest. "Enlarged glands in mediastinum and appearance of slight displacement of aorta to left."

Urine: Negative for albumin, sugar and casts.

March 30. *Bronchoscopic Examination by Dr. H. Arrowsmith.** (Local Anesthesia.)

"Both vocal bands are considerably thickened and very decidedly congested and their free edges are very uneven, showing almost a condition of serration. The tracheal mucous membrane is uniformly congested and thickened.

About one inch above the carina on the posterior tracheal wall is an irregular, apparently fungating mass, perhaps the size of a marrow-fat pea. (Specimen removed for examination—see report under April 5.) There was rather more respiratory movement in the trachea than is ordinarily seen. Tentative Diagnosis: Gumma of the Trachea."

Sputum. Negative for tubercle bacilli.

Second Blood Wassermann. Frankly positive.

Blood Count. Hemoglobin, 90 per cent. White blood cells, 12,200; polynuclears, 65; transitionals, 7; lymphocytes, 13; large mononuclears, 10; eosinophiles, 5.

April 1. 0.6 gm. arsenobenzol given intravenously.

April 2. Temperature reaction up to 102.4° from average of 100°.

Sputum. Quantity in twenty-four hours, 4 ounces.

Clinical Note. "Patient's general and local conditions seem to have improved considerably; he feels better; sleeps better; coughs less frequently and with less of the low-pitched barking quality; and the amount of sputum raised is less. He complains a little of pains behind his shoulders when he lies on his side. These pains have appeared since the injection of arsenobenzol."

Sputum. Amount 3 ounces.

April 4. *Temperature*, 100°.

Clinical Note. "In the left lung the vesicular murmur of the breath sounds can be readily distinguished, the rhonchi having markedly cleared up."

Mercury salicylate, gm. 1, given intramuscularly.

Sputum. Amount 4 ounces.

April 5. *Pathologic report* on the tissue removed during the bronchoscopic examination:

* Since this examination Arrowsmith (Tracheobronchial Syphilis, New York Med. Jour., June 24, 1916, cii, 1211) has published an article on tracheobronchial syphilis in which he comments on the paucity of the literature on the subject and describes in detail a case he had seen in Brooklyn in which his bronchoscopic diagnosis was "diffuse indurative peritracheobronchitis with stenosis." He also mentions this examination.

"Diagnosis. Chronic inflammation of bronchial mucosa of unknown origin.

"Specimen consists of a single bit of tissue, the size of a pin's head, snared from the bronchus with bronchial forceps.

"Microscopic Examination. The sections of the material received show it to be a bit of mucous membrane apparently covered with stratified columnar epithelium. No mucous glands are present in the sections. There is considerable hemorrhagic round-celled and plasma-celled infiltration of the submucosa, but very few polynuclear leukocytes being seen. There are also some evidences of necrosis but none of tuberculosis, nor of malignant process. While the diagnosis of 'syphilis' cannot be made on the microscopic findings there is nothing in the sections that would contra-indicate it."

April 5–8. *Sputum.* Amount, 2 ounces a day.

April 7. *Clinical Note.* "Patient's cough has lost almost all of its deep characteristic barking character."

Arsenobenzol. 0.6 gm. given intravenously.

Temperature. Average 99.5°.

April 8. *Temperature* reaction 102°.

April 9. *Mercury salicylate,* 1 gm. given intramuscularly. *Sputum.* Amount 1 ounce.

April 12. *Sputum.* Amount ½ ounce.

Patient allowed to go home.

Discharge Note. "This is the second case of syphilis of the trachea and bronchi to appear on the division within four months. This man's history of paroxysmal attacks of coughing, his stridulous breathing and his peculiar, deep, barking cough furnished Dr. Conner sufficient grounds for a fairly definite diagnosis of 'syphilis of the trachea.' A first blood Wassermann was reported as indefinite, but a second was strongly positive. Bronchoscopy revealed a small papule just above the carina, section of which showed round-celled and plasma-celled infiltration of chronic inflammatory tissue —not pathognomonic of any certain condition, but at least not contra-indicating syphilis. Active antisyphilitic treatment was started with arsenobenzol and mercury, with marked and early diminution in the severity and frequency of the cough, decrease in the amount of sputum and a pronounced increase in the patient's sense of general well-being. Patient now returns to his own doctor, Dr. Frey, for further antiluetic treatment.

Diagnosis. Syphilis of the trachea.

Result. Improved."

May 7. The patient called at the hospital. "He has had two more doses of arsenobenzol from Dr. Frey, also mercury and iodides. His voice is clearer and he feels much better. There is practically no dyspnea even on exertion, and he can sleep prone. The expansion is apparently equal on the two sides, and the breath and voice sounds are equally well transmitted to the two sides. There are a few

rhonchi on the right side. The patient still coughs quite frequently but expectorates very little. The sputum is no longer blood-streaked."

June 14. The patient again called at the hospital. "He has had one more dose of arsenobenzol, also mercury and iodides. The sense of general well-being continues to improve. All symptoms are less marked."

February 1917. Dr. Conner heard that the patient was in good health and at work, although he still had a troublesome cough at times.

July 9, 1920. Dr. Frey, over the telephone, said that the patient had been critically ill in 1918 with an influenzal pneumonia but survived and is now quite well, though still with the occasional troublesome cough. He believes that the patient, who moved out of town, has had no antiluetic treatment since the summer of 1916.

CASE III.—L. B., female, aged thirty-three years, married, was admitted at 3 A.M., April 11, 1913, the chief complaint being dyspnea.

History. There was no history indicative of congenital or acquired syphilis. She had been married eight years but had never been pregnant. Six years before admission she had a mild "rheumatic attack" characterized by low fever and mild polyarticular joint pains, the joints being slightly swollen but not red. She was sick two weeks and made a perfect recovery.

The present illness began with the first of a series of severe attacks of "bronchitis" about one year before admission. This first attack lasted two weeks, confining her to her bed, and was followed by four or five more attacks, each lasting three or four days, and the last attack occurring about two months before admission. During these bronchitis attacks expectoration was very profuse, at times green, at other times dark brown; and frequently it showed quite a little fresh blood. The cough was paroxysmal and hacking, the paroxysms being frequent and lasting for some minutes, so that the patient would become very cyanotic and extremely prostrated. The patient was somewhat short of breath on exertion during the entire two years before admission, but more marked respiratory distress came on during the last three or four days of the first attack of so-called bronchitis and persisted, the patient at no time becoming entirely free from it. This distress consisted of difficulty in both inspiring and expiring, and at times her respirations became exceedingly difficult and painful, being also accompanied by a sensation of weight and downward dragging beneath the sternum. These exacerbations varied from a few hours' duration to that of three or four days, and occurred every three or four weeks. During these severe attacks of dyspnea her breathing was better when she was in a sitting position, but at other times position seemed to make no difference in her breathing, nor was there any variation with the

time of day. Five days before admission, on her way from Texas to New York City, she was forced to stop in St. Louis because of one of these severe attacks of dyspnea, which lasted about four hours. From then until admission the patient had a continuous but rather less severe difficulty in breathing.

During the year's duration of her illness the patient lost between forty and fifty pounds in weight, and no longer had the strength to be up and around. But apart from her respiratory troubles and her attacks of "bronchitis" she was troubled by no other symptoms except an increasing anorexia and weakness.

Physical Examination on Admission. The patient was an emaciated woman, aged thirty-three years, of slender frame and with gray hair. The skin was very pale and the mucous membranes were also pale and slightly cyanotic. The pupils were contracted, regular and showed a slight reaction to light. The eye-grounds were negative, showing no hemorrhages or exudate or choking of the disk. There was no scleral jaundice. The mouth was normal except for a dry and coated tongue. A laryngoscopic examination showed that the vocal cords were symmetrical and widely separated, but they were not seen to move; no growth or other pathologic process was seen in the examination. ("Urgent dyspnea did not allow protracted examination.") The neck showed swollen veins and marked contractions of the accessory muscles of inspiration. The chin was held constantly in a somewhat elevated position. The chest was narrow but "of fair form." The breasts were normal.

There was marked inspiratory and expiratory dyspnea, the former being the more marked, but both being accompanied by a loud stridor, chiefly inspiratory, however. During inspiration, which was somewhat prolonged, there was rapid descent of the diaphragm, and action of all the accessory respiratory muscles, following which there was a marked sinking-in of the intercostal spaces, which in turn was followed by expansion of the chest. Expiration was also forced, the abdominal muscles being boardlike during this phase. During both phases of respiration, but especially during inspiration, a thrill could be felt over the larynx, trachea and left chest, but not over the right chest. Resonance over the lungs was normal throughout, and there was also resonance over the manubrium sterni and over the dorsal spine down to the fourth thoracic vertebra. Breath sounds were vesicular in character and well heard over both lungs, but were louder on the left side. Over the large bronchi on both sides, but especially on the left side, a coarse stridor was heard, increasing in intensity to the larynx, where it was loudest. The thrill of the stridor was felt over the left lung only. Over both lungs expiration was accompanied by sibilant and occasional sonorous rales, and expiration was greatly prolonged, but these sounds were not so intense nor so numerous as in ordinary asthmatic breathing.

The *pulses* were equal, regular, rapid, of poor force and low tension,

and there was no appreciable arterial sclerosis. As to the *heart*, the area of relative dulness extended from the right sternal margin to 10.5 cm. from the midline in the fifth left interspace. The first heart sound at the apex had poor muscular quality while the second sound at that point was described as booming. At the base the second sound at the aortic area was slightly accentuated and was louder than the second pulmonic sound. No murmurs were heard.

The *abdomen* was soft during inspiration and not tender, and no masses were felt other than the liver edge 2 cm. below the right costal margin. The liver dulness began at the fifth rib. The spleen was not felt. The *extremities* showed no edema. There was a small white scar on the inner side of the left patella. The knee-jerks were active and the Babinski test was negative in each foot. *Lymph nodes* were not enlarged.

Course in Hospital. Admitted April 11, 1913, at 3.15 A.M.; temperature, 100°; respirations, 28; pulse, 100.

At the time of admission the patient had a very bad attack, with great difficulty in breathing, but was somewhat relieved by adrenalin. She dozed toward morning and seemed to rest comfortably. During the day and evening she was given several doses of adrenalin and a total of $\frac{2}{5}$ gr. of morphin, and that evening salvarsan 0.3 gm. was given intravenously. That night her breathing seemed much improved and the patient seemed more comfortable, sleeping somewhat. A blood count the following morning (April 12) showed hemoglobin 72 per cent.; white blood cells, 21,000; 93 per cent. polynyclear, and the sputum showed numerous pus cells but no tubercle bacilli. Two uranalyses each showed a trace of albumin and numerous hyaline casts. Blood taken for Wassermann was later reported as giving a positive test. The patient died at 1 P.M. on April 12, her temperature having varied from 101° to 98°; pulse-rate from 92 to 108 except for a terminal 144; and respiration rate from 20 to 32 except for a terminal 42. The terminal temperature was not taken.

No autopsy was performed.

The discharge note reads: "Several times preceding death the patient became almost pulseless, but became stronger following intravenous injections of digipuratum. The muscular effort necessary to maintain respiration was extremely severe. Patient conscious to within an hour of death. A short period of Cheyne-Stokes breathing set in but disappeared soon after camphor in ether was given. The obstruction to respiration did not appear to be greater today than yesterday.

Diagnosis. Syphilis of right bronchus."

The above account of Case No. 3 is based on the hospital records of the case. She was not seen by the present writer.

Summary. In syphilis of the trachea and bronchi the characteristic symptoms are those of tracheal or bronchial obstruction;

that is, (1) a peculiar type of dyspnea with labored, prolonged inspiration and shorter easier expiration; (2) paroxysms of excessive dyspnea, sufficient to cause syncope or even death; (3) cough, which is usually hard, brassy and paroxysmal, though quite variable in character; (4) stridulous sounds, particularly during inspiration; (5) frequently an inspiratory sinking-in of the tissues of the root of the neck, epigastrium and lower intercostal spaces; (6) other features, such as more or less profuse sputum, a limitation in the mobility of the larynx, etc. Wide variations from this symptom-complex, however, are not uncommon.

Case I shows a history in which the principal symptom was a paroxysmal cough of three and a half months' duration and increasing severity, accompanied by dyspnea and cyanosis. The clinical features were paroxysms of coughing, stridor, cyanosis, fever, great effort during both inspiration and expiration, a smaller respiratory movement in the left chest than in the right, numerous rhonchi and rales transmitted more loudly to the right side than to the left and a positive Wassermann, then respiratory relief obtained from mercury and salvarsan, but death soon after from lobar pneumonia. An autopsy revealed a partial obstruction of the left bronchus due to a gummatous lymph node, stenosis of the left pulmonary artery, lobar pneumonia and syphilis.

Case II shows a history of three years of paroxysms of coughing, which for a year were occasionally severe enough to cause syncope. He also had dyspnea, an audible respiration and a moderately profuse expectoration. The clinical features were the peculiar deep barking cough, the stridor, enough dyspnea to make sleeping horizontally difficult, and asthmatic rhonchi in both lungs; also a positive Wassermann, a chronic catarrhal laryngitis and a papule in the lower part of the trachea, after the removal of which and the administration of arsenobenzol there was a steady improvement in the patient's condition.

Case III shows a history of one year of attacks of "bronchitis," with a severe paroxysmal cough and much sputum, also attacks of difficult painful inspiration and expiration, a fairly constant moderate dyspnea and much loss of weight. The clinical features were marked inspiratory and also expiratory dyspnea, notable contractions of the accessory muscles of inspiration, stridor, and inspiratory thrill over the larynx, trachea and left chest, and vesicular breath sounds that were louder on the left side than on the right, also a positive Wassermann, and death thirty-six hours after admission to the hospital. Autopsy was not done. The clinical diagnosis was syphilis of the right bronchus.

I wish to thank Dr. L. A. Conner for permission to publish the accounts of these three cases and for kindly and helpful suggestions as to the form and substance of the article.

REVIEWS

PRINCIPLES OF BIOCHEMISTRY. By T. B. ROBERTSON, PH.D., D.SC., Professor of Physiology and Biochemistry in the University of Adelaide, South Australia; formerly Professor of Biochemistry in the University of Toronto; Professor of Biochemistry and Pharmacology in the University of California. Pp. 632. Philadelphia and New York: Lea & Febiger.

THAT branch of chemistry which probably possesses the most voluminous literature has the fewest text-books. This is the latest contribution to the field. The *Principles of Biochemistry* is intended for students of medicine, agriculture and related sciences. The range of subjects treated is broad; in addition to the matters one would expect to find discussed in a text-book of biochemistry such subjects as bioluminescence, artificial fertilization and memory also find a place.

As one might expect from the nature of the author's other publications, an effort is made throughout the book to treat biochemistry as an exact science, and mathematical expressions appear much more frequently than in other treatises on the same subject. There is a strong tendency in biochemistry to apply the methods of physical chemistry to life phenomena, and it is well that the task of discussing the subject from this viewpoint has been assumed by one so well prepared to do it. This feature alone makes it a welcome addition to the literature of biochemistry.

The arrangement of the contents is peculiar—perhaps artificial would better describe it. For example, instead of treating alimentary processes as a unit, such closely related topics as the secretion of the digestive enzymes, the actions of these enzymes and the origin of the hydrochloric acid of the gastric juice are described in widely separated places. (The psychic secretion of digestive juices is regarded as physiology and is not discussed.) Vitamines are treated partly in a chapter dealing with nucleic acids and nitrogenous bases because of the assumed chemical composition of these materials, and in another chapter they are mentioned briefly in connection with growth. Their discussion, as a whole, is inadequate in view of the present position of the subject. On the other hand, Robertson's own work on tethelin is considered at length.

Several statements have been noted which outstrip the facts.

On page 193 the hydroxy acids of fruits and vegetables are referred to as antiscorbutics. On page 489 this statement with reference to vitamines occurs: "They evidently represent a group of non-synthesizable essential constituents of living matter which would appear not to be excessively complicated in structure, since they are usually obtainable in crystalline form and their relationship to the pyrimidine and purines has frequently been established."

The chemistry of the simple carbohydrates and of the proteins is so well done as to deserve special mention. R. L. S.

THE PASSING LEGIONS. By GEORGE BUCHANAN FIFE. Pp. 369; 8 illustrations. New York: Macmillan Company.

MR. FIFE has portrayed here, in an interestingly narrative fashion with many amusing anecdotes and stirring tales of human interest, the story of the splendid service rendered by the American Red Cross to the thousands of our soldiers who passed through England *en route* to France, and to our sailors at the American base ports in Great Britain. The book is well worth reading as a side light on our diversified efforts in the war. P. F. W.

HEART AFFECTIONS; THEIR RECOGNITION AND TREATMENT. By S. CALVIN SMITH, M.S., M.D., Instructor in Medicine, University of Pennsylvania Graduate School of Medicine; Visiting Physician to the Philadelphia General Hospital. Pp. 440; 83 illustrations. Philadelphia: F. A. Davis Company.

THE need of a new volume dealing with the disorders of the heart and the bloodvessels does not seem especially to be marked. However, if such a demand exists it is certainly in the demand for a book which deals with the essential elements of cardiac affections and not with the more complicated and advanced studies which have appeared in the last few years. Because of this fact, Dr. Smith has limited his volume very largely to the fundamentals. He describes all that is to be told about the heart and its diseases in language so clear and concise that it can readily be comprehended by a beginner in the field of cardiology.

In general the first two chapters have to do with the elements of cardiac anatomy, physiology and pathology. The succeeding chapters deal with a systematic outline of disorders of the heart and the last three chapters concern cardiac treatment largely. More in detail it may be said that Dr. Smith, in the first portion of the outline of disorders of the heart, takes up the physical examination of

the body, laboratory aids to diagnosis, graphic methods of examination, blood-pressure and so on. He then discusses pathological heart conditions as well as arteriosclerosis and aneurysm. These last two diseases might well have been omitted if the author did not care to discuss them more fully. To neurocirculatory asthenia, a condition which, in its true sense, has no direct relationship with cardiac conditions, is allotted one of the last chapters, while the book closes with an alliterative chapter on "cardiac camouflage." Dr. Smith has prepared his book very carefully. It is not too technical nor too deep for the average practitioner. and should be a great help in teaching him more about cardiac conditions. Sane judgment is used in the description of methods of diagnosis and treatment. A great deal of the author's teaching reflects the sound, good sense of McKenzie and of Lewis, for whom the author apparently has a great admiration. J. H. M., Jr.

The School of Salernum (Regimen Sanitatis Salernitanum) The English Version. By Sir John Harington. Pp. 216; 21 illustrations. New York: Paul B. Hoeber.

Prefaced with a history of the School of Salernum by the editor, Dr. F. R. Packard, and a historical note by Dr. F. H. Garrison, the present edition of this quaint old work is very carefully prepared for new readers. As a medical treatise this book was supposed to have been written for the advice of Robert of Normandy, son of William I of England. Almost numberless copies were made in manuscript in the middle ages, and since the time of printing there have been many editions. Harington's English version was printed in 1607 and was to be sold "at the little shop next Cliffords Innegate, in Fleet Streete." The illustrations are taken from early editions of the work. In the Ad Librum we are told that then as now, Belgium was devastated by wars. Both English and Latin versions are given and excellent notes complete the book. To all those who are interested in the historical side of medicine this volume will always appeal. W. H. F. A.

A Text-book of Physiology. For Students and Practitioners of Medicine. By Russell Burton-Opitz, M.D., Ph.D., Associate Professor of Physiology, Columbia University. Pp. 1185; 538 figures. Philadelphia and London: W. B. Saunders Company.

In this newest American text-book of physiology for students and practitioners of medicine is given the substance of the lectures

which the author has elaborated for his undergraduate classes. The subject is considered in nine parts, of which the longest, containing 192 pages, is devoted to the circulation of the blood, a field in which the author has made special studies. Frequent references to special articles are given in footnotes. These references are mainly to the classical papers on the various topics, although the recent literature is not neglected. The point of view of the author is indicated in the preface, wherein he states that the sole hope of modern medicine is physiology, or, in a larger sense, the experimental sciences. Hence follows the necessity of the student making a conscientious effort to become thoroughly acquainted with this subject. In this book are given all the needful data to accomplish this end. But it would appear at times that the author is a little in doubt as to the student's previous preparation for the task. Mindful of the average person's slowness in correlating the many branches of his knowledge, the author has introduced many brief descriptions in the fields of comparative physiology, histology and embryology as well as physics and chemistry. It is no doubt helpful to give these passing references in the course of systematic lectures, but they seem at times to be unnecessary in a text-book of physiology of this kind. In some of the histological descriptions of organs which are introduced the delineation is so diagrammatic as to present few points of contact with the student's previous instruction. In such cases it would perhaps be more productive of clear thinking to refer the student to the special books on the subject. The volume is well printed and is free from typographical errors. It will doubtless have a wide field of usefulness. W. H. F. A.

COMMON INFECTIONS OF THE KIDNEYS WITH THE COLON BACILLUS AND ALLIED BACTERIA. By FRANK KIDD, M.B., B.C. (CANTAB.), F.R.C. (ENG.). Surgeon to London Hospital; Surgeon-in-Charge of Genito-Urinary Department, London Hospital; Member of the International Society of Urology, with an additional lecture by DR. PHILIP PANTON, Clinical Pathologist, London Hospital. London: Henry Frowde, Oxford University Press.

THE second book in the series of *Common Diseases* which Mr. Kidd has recently brought forth is an interesting and valuable contribution to the subject of renal infection. The author in the first part of the book discusses blood-born bacterial infections of the kidneys, hematogenous prostatitis, blood-born bacterial infections of the testicle and active hematogenous infections causing spontaneous infection of the bladder. The last chapter in this section is on bacteriology of the urine by Dr. Panton.

These first chapters are well written and instructive, but not nearly as interesting as the chapters in the second section, which

has to do with the theory and the genesis of the various conditions discussed in the first section. The author believes that the body is a bacterial sponge and that the organisms are constantly invading the blood stream, which are soon passed out through the kidney and lungs. If, however, bodily resistance is lowered and the body tissues are not able to handle these organisms we get the various acute and chronic infections in different parts of the body which produce such conditions as rheumatism, lumbago, headache, toxemia and common colds, which the author contends, are nothing more or less than intermittent bacterial infections of the body. In some cases more severe infections are produced and we have the more serious diseases. The author's ideas are interesting and comprehensive, and if he could substantiate his theory we would have a very complete explanation for practically every type of disease to which the body is heir. J. H. M., Jr.

Medical Clinics of North America. St. Louis Number, November, 1920. Philadelphia Number, January, 1921. Philadelphia: W. B. Saunders Company.

These interesting medical publications continue in much the same form as heretofore. Various subjects are presented or cases are reported with full discussion which are of interest from some diagnostic, therapeutic or prognostic standpoint. The clinics of these two numbers are for the most part very interesting and are well worth reading. The studies are presented in a more intimate manner than is possible in a text-book, and with less formality than is possible in a medical article, greatly enhancing their readability. J. H. M., Jr.

The Community Health Problem. By Athel Campbell Burnham, M.D., Health Service, Atlantic Division, American Red Cross; Attending Surgeon, Volunteer Hospital, New York City. Pp. 149. New York: The Macmillian Company.

The increasing interest in the questions of public health is well exemplified by a number of books relating to various phases of this subject which are now appearing. Thus the latest volume that the reviewer has seen is concerned largely with the question of public health in a local community and deals with such subjects as the private physician in his relation to community health, the health departments in their relation to community health, public health nursing, health centers, industrial medicine and similar subjects. The discussion of these subjects is both sane and logical. The chief

criticism of the book would be in the extreme brevity of the different subjects it discusses, which are touched upon so lightly that one gets but a superficial survey of the broad field of public health measures. After reading the book one has the idea in a general way of what may and can be done in public health, but one is left under the impression that little is said of how it should be done.

J. H. M., JR.

BLOCK ANESTHESIA AND ALLIED SUBJECTS, WITH SPECIAL CHAPTERS ON THE MAXILLARY SINUS, THE TONSILS AND NEURALGIAS OF THE NERVUS TRIGEMINUS. By ARTHUR E. SMITH, D.D.S., M.D., Oral Surgeon to Frances Willard Hospital and to the House of the Good Shepherd, Chicago. Pp. 872; 595 illustrations. St. Louis: C. V. Mosby Company.

THE perfection of synthetic local anesthetics and the improvement in the technic of their administration is such that today a large majority of all operations can be successfully performed without general narcosis. By the block method, local anesthesia has been brought to a degree of perfection which is almost ideal. Its application to the structures of the head and face finds probably its most useful field, and in this complete treatise of the subject, Dr. Smith has furnished for oral surgeons, dentists and laryngologists a text-book of great value.

It is perhaps surprising that it is possible to write a book of some nine hundred pages solely on local anesthesia as applied to the head, but, as in all surgical procedures, it is the attention to details that makes for success, so it is the detail of description and illustration that makes this book of especial merit.

For practical purposes, however, it is possible to have too much elaboration, in that it makes it difficult to grasp the essential points without an unnecessary expenditure of time and effort. In fact, the chief criticism of this book would lie along these lines.

Two very interesting chapters are devoted to the history of anesthesia and its development. The anatomical chapters are very complete, comprising the whole range of the cranial nerves from the histology of a neuron to a detailed description of the terminal anastomoses. It would seem, because of the great amount of space that is devoted to the various methods of anesthetizing the teeth, that the book is especially designed for the use of the dentist; but practically all forms of head surgery, including that of the nose, throat and ear, are completely covered, and with the usual amount of detail, making the book most valuable to the otolaryngologist. There are descriptions of the best methods for producing local anesthesia for mastoid operations, for the removal of goiters, for tonsil and sinus operations and of injections for the relief of the

various neuralgias, and in many cases the author even describes the various operations that the local anesthesia makes possible. The relative value of the different anesthetics has been determined not only from the published statements of others, but also from personal experiments. Their general and local actions and the pathology of the tissues when injected are also carefully considered. In quite a number of the described methods there is considerable originality shown, as, for instance, in the suggested procedure for blocking the sphenopalatine ganglion. It is apparently much simpler and much less pregnant of harm than the classical method of Sluder. Extensively illustrated mostly with photographic reproductions, but also with carefully prepared diagrams and drawings of instruments, we have in this treatise a comprehensive and practical survey of the whole subject of local anesthesia as applied to the head and neck.

We compliment the author on the production of this work and congratulate those surgeons who are privileged to read it.

G. B. W.

PARACELSUS. By J. M. STILLMAN, Professor of Chemistry Emeritus, Stanford University. Pp. 184. Chicago and London: Open Court Publishing Company.

THE reader will find set forth in brief compass a readable and patently authoritative account of the place occupied by Paracelsus in medicine and chemistry. The unbiased viewpoint of the author is evident throughout, and on finishing the book one feels that he has become acquainted with the belligerent, truth-seeking Swiss physician of the sixteenth century about as well as one can at this late date, considering, in addition to the inherent difficulties of such a biographical task, the deliberate falsehoods circulated by Paracelsus' enemies and the extravagant flatteries originated by his disciples.

R. L. S.

PHYSIOLOGICAL CHEMISTRY. By A. P. MATHEWS, Professor of Physiological Chemistry, University of Cincinnati. Pp. 1154. New York: William Wood & Co.

THIS text-book is now so well known that a review is superfluous. The third edition differs from the second chiefly in the enlargement of the practical part. This comprises 268 pages in the present edition instead of 164 in the previous one, and is now comparable with books which are exclusively laboratory guides. The most recent of the methods for the analysis of blood and urine are included. The only important omission noted was the method of Van Slyke for acetone bodies.

R. L. S.

PROGRESS

OF

MEDICAL SCIENCE

MEDICINE

UNDER THE CHARGE OF

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The Retinitis of Diabetes Mellitus.—WAGENER and WILDER (*Jour. Am. Med. Assn.*, 1921, lxxvi, 515). Forty-five cases of retinal disease were noted in the course of a study of 300 diabetics at the Mayo Clinic. About 80 of the total number of cases represented were examples of so-called "diabetes gravis," characterized by acute onset of the disease and its progressively increasing severity, and not one of these showed retinal changes. Retinitis occurred exclusively in diabetic patients, with mild, easily controlled glycosuria and in whom evidence of vascular disease was always present. They believe that "the retinitis of diabetes is the retinitis of cardiovascular-renal disease, modified in appearance and in stage of occurrence, possibly by the metabolic disturbances associated with the diabetes."

Immunological Distinctions of Encephalitis and Poliomyelitis.—AMOSS (*Jour. Exp. Med.*, 1921, xxxiii, 187). The author recalls that some observers believe encephalitis and poliomyelitis to be manifestations of the same disease, and that many have noted points of similarity. He summarizes the main differences existing between these two diseases as follows: (1) In lethargic encephalitis the clinical manifestations depend in the main on basal ganglion lesions; in poliomyelitis the main lesions occur in the gray matter of the spinal cord and medulla oblongata. (2) The tendency for poliomyelitis to occur in the summer and autumn months and for lethargic encephalitis to occur in the winter and spring months. (3) Differences in communicability of the disease to monkeys. Poliomyelitis is transmitted with ease by

inoculating monkeys with affected nervous tissue from man, while it is doubtful whether lethargic encephalitis has ever been so transmitted. The author then applies, as a means of distinguishing the two diseases, protection experiments. Under certain circumstances the blood serum of convalescent poliomyelitis cases neutralizes the virus of poliomyelitis when the latter is injected into monkeys. Blood serum from four convalescent encephalitis cases (fifth week, fourth month, fifth month and fifteenth month) gave no protection to monkeys against subsequent inoculation with the virus of epidemic poliomyelitis. The monkeys (controls) which were protected by serum from a monkey which had had experimental poliomyelitis survived.

Pseudo-polycythemia; Extraordinary Blood Changes in a Patient with Renal Calculus.—HERMAN and LYON (*Annals of Surgery*, 1921, lxxiii, 223). The authors report an unusual case of polycythemia in a patient, aged forty-nine years, coming under observation for renal calculus and pyelitis. The blood showed 11,496,000 red blood cells; hemoglobin, 120 per cent.; and 11,600 white blood cells before operation. No cyanosis, splenomegalia nor other signs of polycythemia were present. Three days after removal of the affected kidney the blood picture showed a remarkable change: red blood cells, 5,504,000; hemoglobin, 108 per cent.; white blood cells, 11,200. Thirteen days after operation the red count and hemoglobin were found to be normal, but there were 242,000 leukocytes, with the following differential formula: Polymorphonuclears, 74 per cent.; small mononuclears, 13 per cent.; large lymphocytes, 4 per cent.; transitionals, 5 per cent.; acidophiles, 4 per cent.; and basophiles, 1 per cent. Four days later the blood examination was reported as follows: Red blood cells, 4,360,000; Hemoglobin, 88 per cent.; white blood cells, 22,800. Differential formula: Polymorphonuclears, 81 per cent.; lymphocytes, 16 per cent.; transitionals, 2 per cent.; acidophiles, 1 per cent. Convalescence from operation was uneventful. One year after operation the blood was found to be normal.

Angina Pectoris; An Electrocardiographic Study.—WILLIUS (*Arch. Int. Med.*, 1921, xxvii, 192). The author studied 155 cases of angina pectoris. Nineteen (12.2 per cent.) had recognizable aortic disease; 2 (1.3 per cent.) had mitral stenosis; 134 (86.5 per cent.) had "indeterminate pathological lesions, granting that we must discard the view of coronary disease accepted as true for many years and revealed at necropsy innumerable times." The author finds it difficult to classify this last group (86.5 per cent.) without utilizing the coronary disease hypothesis as the explanation of their angina. Of the total number (155) 128 were male and 27 were female patients. The greatest number (59) occurred in the sixth decade, 45 occurred in the seventh decade and 34 in the fifth. Seven patients in the series had angina, with no demonstrable objective evidence (including significant electrocardiographic abnormalities) of heart disease. From the study Willius arrives at the following conclusions: "(1) There are no electrocardiographic findings pathognomonic of angina pectoris. (2) Significant *T* wave negativity occurred in one-third of the electrocardiograms (32.9 per cent.) and is an important abnormality. (3) Abnormalities in *T* wave contour affecting both the positive and negative wave are

significant. (4) Abnormal *QRS* complexes in all derivations of the electrocardiogram occurred in 14.2 per cent. of the records. (5) The cardiac mortality of the entire group was 46.7 per cent., definitely contrasted with the higher mortality of those patients having significant *T* wave negativity (70.3 per cent.) and abnormal *QRS* complexes in all derivations (62.5 per cent.) of their electrocardiograms."

SURGERY

UNDER THE CHARGE OF

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Multiple Polyposis of the Intestinal Tract.—STRUTHERS (*Annals of Surgery*, 1920, lxxii, vi, 849) says that multiple polyposis of the intestinal tract is a serious disease from the standpoint of morbidity and mortality. The etiology of the intestinal polypus is not known, although chronic ulcerative colitis and intestinal infections appear to be factors. There is no specific medical treatment and operation undoubtedly offers the best results in the more advanced cases. The rectum, the sigmoid, and the splenic and hepatic flexures are most frequently involved. The small intestines are rarely involved. The predominant symptoms are diarrhea, with the passage of pus and blood, vague abdominal pain, and rectal tenesmus. The so-called essential hemorrhage, if present, is almost pathognomonic. Proctoscopic examination should be done routinely in all cases of dysentery. Adenomas do not seem to become malignant more often than polypi and papillomas. In cases in which polypi were associated with carcinoma, they were usually found below the cancerous growth farther along in the intestinal tract. Most marked involvement of the colon is found in the cases which begin as a mild diarrhea and later become chronic. The more sudden and severe the onset the more localized the condition in the colon. Multiple polyposis of the intestinal tract is more frequent in males than in females, a proportion of 2 to 1.

Persistence of Pyloric and Duodenal Ulcers Following Simple Suture of an Acute Perforation.—LEWISOHN (*Annals of Surgery*, 1920, lxxii, v, 595) says that immediate gastro-enterostomy in the treatment of perforated pyloric and duodenal ulcers does not increase the mortality. Gastro-enterostomy and pyloric exclusion simplifies the postoperative treatment considerably. Simple closure of the perforation will not cause a cure of the ulcer in a considerable number of cases. Gastro-enterostomy will guarantee proper drainage of the stomach contents and overcome partial obstruction of the pylorus caused by postoperative adhesions. Closure of the perforation, gastro-enterostomy, and pyloric

exclusion should be the method of choice in the treatment of perforated pyloric and duodenal ulcers. Simple closure of the perforation should be reserved for only those patients whose general condition is so poor that even a rapidly performed gastro-enterostomy would be too much of an operative risk.

The Bacteriology of Infected Wounds with Especial Reference to the Importance of Streptococcus Hemolyticus.—SWEETSER (*Annals of Surgery*, 1921, lxxiii, i, 4), gives the data and conclusions based on an analysis of a bacteriological work done at Base Hospital 15 of the A. E. F. Anaërobes are prominent in the early bacteriologic picture of wounds but disappear in a short time. Aërobes become progressively more prominent. The streptococcus has a fairly constant incidence and is very persistent. A combination of Streptococcus hemolyticus and Staphylococcus aureus was the most common of all associations in wounds. That association was particularly frequent in fatal wounds. Streptococcus hemolyticus, Staphylococcus aureus, Bacillus welchii, Bacillus coli communis, Bacillus proteus, and to a less extent, Staphylococcus albus, were the bacteria appearing most often in both the fatal and non-fatal cases. The prognosis seems to have been good in cases showing Staphylococcus aureus or other aërobes aside from streptococcus. Here the most interesting point is that an association with Staphylococcus aureus seemed to lower the virulence of infection with anaërobes. Infections with anaërobes showed a high death-rate, but a short-period of danger to life, unless the anaërobes were associated with streptococcus. Deaths from streptococcus infection were numerous and occurred at least up to the end of the fourth month. The mortality was even higher where streptococcus was associated with Staphylococcus aureus or with anaërobes. Conversely: Cases fatal early usually showed anaërobic infection; those dying late invariably showed streptococcus infection. Most of the early improvements and cures were cases of infection by aërobes other than streptococcus, while the improvements and cures that were tardiest generally showed infection by streptococcus without anaërobes, or by streptococcus and Staphylococcus aureus without anaërobes. Secondary suture of wounds failed in some cases apparently because the interval between the injury and primary surgical treatment had been too long, and in other cases because the secondary suture was attempted too soon. Gas infection was most often found in wounds of heavily muscled parts of the body; fracture of bone was not an essential factor; anaërobes frequently contaminated without infecting wounds. A streptococcus bacteremia was apparently by far the most important cause of death in cases of gunshot wound. The culture of infected wounds is certainly valuable, even if only for the purpose of determining the presence of Streptococcus hemolyticus.

Reduction of Old Dislocations of the Hip by Open Incision.—BUCHANAN (*Surg., Gynec. and Obst.*, 1920 xxxi, v, 462) says the exact time at which an unreduced dislocation of the hip becomes old cannot be definitely stated, but traumatic hip dislocations may be considered old at the end of four weeks. Reduction by manipulation is rarely successful after that time, owing to formation of connective tissue,

which fills the acetabulum and binds down the head and neck. Reduction by open incision is to be preferred in nearly all cases of old hip luxations and with modern methods is attended with but little danger. Preliminary traction by Buck's extension is of advantage. The actual replacement of the head, after the acetabulum has been emptied and the head and neck released, is best accomplished by manipulation or the use of levers with manual and body traction. The result is often ideal and, in the cases reported, has been good in 80 per cent.

PEDIATRICS

UNDER THE CHARGE OF
THOMPSON S. WESTCOTT, M.D., AND ALVIN E. SIEGEL, M.D.,
OF PHILADELPHIA.

Report of a Case of Malignant Thyoma with Necropsy. — FOOT (*Am. Jour. Dis. Children*, July, 1920) reports a case of a boy aged nine years who died during anesthesia for an exploratory operation. On necropsy a very hard, lobulated mediastinal tumor was found, occupying chiefly the anterior mediastinum. It lay just behind the sternum, but did not infiltrate the bone. Metastases by direct lymphatic extension were seen with three possible minor metastases at a distance. The lungs and neighboring organs were not penetrated much more deeply than their serous coverings. The tumor was composed chiefly of small cells resembling microlymphocytes, but having vesicular nuclei, acidophile cytoplasm and tending very slightly to anastomose with one another by means of slender processes. This was seen only in a very few, most being collaginous connective tissue. Neighboring lymph glands showed a few discrete cells in their sinuses, but were not, as a rule, incorporated in the tumor mass. A review of the literature of this subject, together with information from this case, seems to point rather strongly to an epithelial origin of the tumor. At first the cells seem almost identical with the microlymphocyte, but once it begins to differentiate the similarity rapidly is lost. While it would seem wisest not to emphasize too strongly an argument based on a series of transitional changes pieced together from a group of cases occurring in individuals of different ages and reported by a number of observers, such a series is very suggestive and not unsupported by supplementary evidence from the embryologic standpoint. There are small celled sarcomatoid tumors as well as carcinomatous. In the tumor studied here there was little reason to consider it as of infectious origin, while there was a great deal to point toward its being a true neoplasm. There seems little doubt that these small-celled thymic tumors, whether lymphosarcomas or not, are still of thymic origin, and are different from the lymphosarcomas that arise in lymph nodes.

Infrequency of Intestinal Parasites in Young Children.—MCLEAN (*Jour. Am. Med. Assn.*, June 26, 1920) made a study to determine the

frequency of helminthiasis in children attending the out-patient department in New York City. A number of studies have been made in recent years to determine this point, but most have been done on children over three years of age and in institutions where the incidence of disease is higher than in children living at home. The out-patient department where the stools were examined is not a neighborhood clinic, but the patients come from all parts of the city, and are perhaps of a class superior in intelligence and receiving better hygienic care than the attendants at a neighborhood clinic. The studies covered a period of five months and were made at random without any reference to symptomatology. Many of the examinations were made on stools from children who came to the clinic along with a sick brother or sister. Others came only for vaccination. It was found that a history of symptoms commonly associated in the minds of the laity with the presence of intestinal parasites could be elicited frequently from the parent of children over twelve months of age. These were restlessness at night, grinding of teeth, picking the nose and lips, loss of weight, capricious appetite and irritability. Examinations were made on 208 stools in children up to twelve years of age, 2.27 per cent. harboring parasites. There were 3.7 per cent. of positive examinations in 189 examination of children from two to twelve years. In a group of 69 children from four to twelve years, 5.7 per cent. were positive. In 53 stools of infants in the first year and 66 in the second year no parasites or ova were found. If the statements of the parents could be accepted regarding their findings of worms in the stools the percentage would be higher. Fruit skins and strings of mucus may be readily mistaken for worms by the anxious parent, and this accounts for the number of cases in which the parasites have been seen by the mother and not found in the laboratory.

Fat Metabolism in Health and Disease. — HUTCHINSON (*Quart. Jour. Med.*, April, 1920) found from a study of the stools that the digestion of fats in infantile atrophy, rickets and tetany is carried out as efficiently as in healthy children. The fat output in the feces varies directly with the fecal weight and formed approximately one-third of this. In order to determine whether the percentage absorption was normal or not it was necessary to take the fecal weight into consideration. When the fat intake was under 20 gm. per day both fat intake and fecal weight affected the percentage absorption; the fecal weight was the predominating factor. When the intake was over 20 gm. per day the intake was not considered and the percentage absorption depended on the fecal weight. The lower average percentage absorption in infantile atrophy was due to the lower average fat intake. There was a slightly greater loss of fat in infantile atrophy due to the stools being larger than in healthy children. The excessive loss can be neglected as far as nutrition is concerned as there is not a true deficient absorption. In rickets the excess loss of fat per day over that in healthy children average 0.6 gm., which is a sufficient amount to affect nutrition. In tetany the loss was 2.4 gm. per day, which was due chiefly to the passage of larger stools and to a less degree to a true deficient absorption. Since the fat in the feces averaged 38 per cent. other facts point to a normal fat absorption in infantile atrophy, such

as the increased amount of fat absorption, with an increased intake and the fact that improvement frequently follows lowering of the fat content of milk. Saponification of fats in the intestine does not affect the absorption of fats. The author points out that the fairly constant percentage of fat in the feces of man and other animals suggests that fecal fat has a function, although he does not suggest what the function may be.

OBSTETRICS

UNDER THE CHARGE OF

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Seven Hundred and Fifty Obstetric Cases in Private Practice.—REEVES (*Jour. Kansas Med. Soc.*, 1919, p. 177) gives the results of his experience with private patients in his obstetric work. Thirty-two per cent. of these were primipara. His statistics showed the usual frequency of presentations while his percentage of bladder operations is not excessively high, 11.2 per cent. As was to be expected, out of 88 operations 58 were done in primpara. In 3 per cent. of his patients he performed version, 23 cases, and this was done for three indications: (1) posterior rotation of the occiput; (2) transverse position with shoulder presentation; (3) eclampsia. The writer believes that version done at the proper time is a more safe and easy operation than the use of high forceps. No Cesarean sections were done in this series, although in the writer's opinion it would have been better to have done this operation in three cases. In two of these version was done and in the remaining case the forceps was used. The mothers survived, but the children were lost. The writer had five patients with eclampsia, two of whom died. All of the children survived. Two hours after delivery by forceps a primipara, aged twenty-nine years, had inversion of the uterus. There were 5 cases of mammary abscess in primipara after they had left the writer's care. Three patients had puerperal sepsis, one of whom was infected by the dirty hands of a drunken husband, the case terminating fatally. The second patient was infected by unclean dressings and infection developed in the third case after version for an impacted breech presentation. There were 2 cases of fibroids complicating labor, one of which was delivered of a macerated child by forceps and hysterectomy was subsequently done; while in the other the fibroid caused a severe postpartum hemorrhage because the uterus could not contract. There were 2 cases of premature separation of the placenta, in both of which the child was lost. A young primipara died soon after delivery and another two hours after an easy forceps delivery, without hemorrhage. Autopsy failed to reveal an adequate cause for death. There were 4 cases of postpartum bleeding: 1 from uterine inertia following the birth of twins in a primipara, 1 from uterine fibroids, 1 where a placenta was adherent and retained and 1 where a uterus failed to contract in a primipara after

she had been delivered by forceps. Twins were seen in 11 cases, triplets once. Only 0.5 per cent. of the mothers of the writer's patients could not nurse their children. The writer used pituitrin in 78 cases, in 2 of which there developed hour-glass contraction of the uterus, with retained placenta. His experience leads him to believe that the safest dose of pituitrin is 5 to 7 minims, and that all larger doses are distinctly dangerous.

Glycosuria in Pregnancy.—CAMERON (*Canadian Med. Assn. Jour.*, 1919, p. 723) in examining the urine of a patient in the fifth month of pregnancy found small quantities of a reducing sugar.

The Prolonged Retention of the Placenta.—LENCANE and PROMSY (*Ann. de gynec. d'obst.*, October, 1919) contribute a paper concerning the possible relationship of growths of the chorion and retained fragments of placenta. Fragments of placenta are often retained in the uterine cavity for a considerable time. They are sometimes considered benign tumors, capable of assuming malignant characteristics. The writers believe that a change from placental tissue to chorionic epithelium is altogether exceptional, and so far has not been proved. A placental polyp should not be considered a benign tumor for it does not grow by the proliferation of its own elements which extend into adjacent tissue as tumors usually do. The best conception of the retained placenta is that it is a sort of graft which may continue to survive occasionally for a long time through the maternal circulation, which in the end is either absorbed or eliminated. The accumulation and organization of clotted blood produces the apparent increase in the size of this region, portions of the placenta, and this is comparable to a thrombosis which grows along the bloodvessel. These prolonged retentions of placental tissue are residue with a precarious life, having only a transient existence in the organ where they are retained.

Inversion of the Uterus and the Report of a Case of Sixteen Months' Standing.—BOYD (*Am. Jour. Obst.*, 1919, lxxx, 161) reports the case of a woman in her third labor, delivered by forceps of a child weighing nine pounds. There was free bleeding after delivery, and when the uterus was compressed suddenly the fundus left the operator's hand and the uterus and vagina became completely inverted. A firmly adherent placenta was attached to the top of the uterus. The hemorrhage was alarming and continued until the placenta was detached. An attempt was immediately made to replace the uterus, but failed, and seven hours after delivery the patient was anesthetized and a second attempt made to invert the uterus by taxis. This was unsuccessful. Abdominal section was performed and the constricted cervix was dilated by inserting the fingers through an abdominal incision into the crater-like cavity. At the same time pressure was made on the fundus through the vagina and the uterus was replaced. A douche was given and the uterus firmly packed with gauze. Complete recovery in the third week of the puerperal period ensued. A second case was that of a primipara who had a prolonged but spontaneous labor. The placenta was adherent and traction was made and inversion of the uterus occurred. The patient stated that she bled freely and that a mass protruded out of the vulva.

The physician who attended the patient did not recognize the nature of the difficulty and made no attempt to replace the uterus, but told her that this tumor should be removed in forty days. During the puerperal period there was free bleeding, but no other complication, nor did symptoms of infection develop. The mother nursed her child until it died at the age of eleven months. Seven months later she had free bleeding, for which she was obliged to remain in bed. Her physician then told her that the uterus was out of place. About a year and a half after the original accident the true state of the case was discovered. At that time involution had taken place, but the uterus was completely inverted, filling the cavity of the vagina, and when touched bled freely. After the parts had been made as aseptic as possible a metal catheter was introduced into the bladder, the perineum was depressed and the uterus was drawn down with a double tenaculum inserted in the fundus. A transverse anterior vaginal incision was made just above the cervix and the bladder separated without opening the cul-de-sac. A median longitudinal incision was then carried through the anterior lip of the cervix, thus removing the cervical constriction. An attempt was made to replace the uterus, but without success. The anterior cul-de-sac was opened and a longitudinal incision made in the anterior wall of the uterus to completely sever the uterus and this was carried to within 1 cm. of the fundus. When the cavity of the uterus was laid open the tubes were found invaginated, but normal and without evidence of adhesions. The uterus was replaced by pulling upon the divided lips of the cervix and forcing the fundus upward with the thumbs. This produced a bulging of the anterior uterine wall, which required partial resection in order to close the uterus accurately. The tissues were brought together by catgut sutures and the vagina replaced in the pelvic cavity. The vaginal incision was closed after the peritoneum had been sutured to the uterus. A gauze drain was placed in the vaginal wound between the bladder and the uterus and another in the uterine cavity. Aside from the mild infection, with slight fever, the patient made a good recovery.

A Modification of Porro's Operation.—Lecocq (*Ann. de gynec. d'obst.*, October, 1919) describes an operation done in 1911 by his former chief, Reymond. He had occasion to remove a pregnant uterus at term containing a living infant without the preliminary opening of the womb, treating it as one would a large fibroid tumor. In this way loss of blood was prevented, mother and child making a good recovery. Lecocq himself has done this in 4 cases, losing one mother from peritonitis, but saving all the children. The indications for this procedure are those recognized for hysterectomy or Porro's operation. They are probable infections of the uterus in cases in which birth through the natural passages is impossible or highly dangerous. Again, when the uterus contains fibroids or malignant growth and rapid delivery must be done because uterine rupture is threatened, when there is complete uterine inertia and Cesarean section is indicated and when the patient has placenta previa with severe hemorrhage, or has hemorrhage into the uterine muscle, and also to obviate the danger of osteomalacia. In doing the operation one proceeds as in hysterectomy, clamping the broad and round ligaments, incising the peritoneum anteriorly and

stripping off the bladder. The uterine arteries can then be made out and clamped and the vagina or cervix is cut across rapidly. When the second uterine artery is clamped the circulation of the mother in the pelvic regions is threatened, and this may bring about asphyxia in the child. To obviate this the writer advises that one of the uterine arteries be cut between two clamps and that the vagina or cervix be severed near the second artery, so that when everything is ready the second artery is clamped and the uterus removed. The assistant to whom the uterus is given opens it on the anterior wall, removes the child, ties its cord and if necessary resuscitates. The operator finishes the operation then as in an ordinary hysterectomy.

Cesarean Section.—Essen Möller (*Arch. mens. r. oster o. et de Gynec.*, April, 1919) gives the results in 106 cases of Cesarean section at the Maternity at Lund and raises the question as to whether obstetricians should save the child in this way at considerable risk to the mother. He believes that the results are now so good that the operation should be done when any reasonable indication exists. In 10 cases done for eclampsia 3 died, but the operator had waited until the patients were in desperate condition before operating. He thinks vaginal Cesarean section preferable in eclampsia when the condition of the tissues permits. For placenta previa seven sections were done, one woman dying, probably from embolism. Fatal embolism after even version has been known in these cases. He would not have recourse to Cesarean section after placenta previa unless hemorrhage was profuse, the cervix not sufficiently dilated for versions and the mother certainly not infected. In one patient Cesarean section was done, although it was known that the child was dead. Hemorrhage during the operation was very little, much less than if one had waited for a spontaneous dilatation of the cervix. In operating for myomatous tumors complicating pregnancy he first abstracts the child and then removes the uterus. He considers abdominal Cesarean section much better than version or embryotomy. The woman is free from infection. When, however, the slightest suspicion of infection arises he tries version or forceps to avoid perforation of the living child. If the conditions are such that the child cannot be born living, or if there are absolute indications for it, Porro's operation is performed. In 8 cases of this sort all of the mothers recovered. The most important point is to decide when the operation should be done. The writer does not have faith in prophylactic measures nor does he believe in waiting until the woman is in danger of infection. He believes that in discussing Cesarean section the result obtained for the children should be regarded as well as for the woman. Only one child was lost, and this occurred from umbilical hemorrhage, which might have been avoided. The other 105 infants were safely born except the seven that were stillborn and one that succumbed to the effect of malformations.

Estimation of Fats, Cholesterol and Sugar in the Blood of Thirty Pregnant Women.—Schiller (*Surg., Gynec. and Obst.*, November, 1919) examined the blood of 14 pregnant women in the later months of gestation, 10 who were at term, 5 who had been delivered and one in the third month of pregnancy. The object of his research was to estimate the

fats, cholesterol and sugar in the blood. In making this investigation he reviewed the work of Morris, Letschke, Kemperer, Simmons, Hermann and Neumann. In studying the presence of cholesterol he injected a watery extract of corpus luteum into the blood, which produced rapidly a temporary hypercholesteremia. A similar result was obtained from adrenalin. Evidently there is a close relation between the endocrine glands in pregnancy and the increase in fats and lipoids. The conclusion of his experiments led him to believe that in the later months of pregnancy after the first two weeks in the puerperal period there is no hyperglycemia. During this time glycosuria and alimentary glycosuria are explained by the activity of the glands of internal secretion or as a hyperrenal function. In pregnancy hyperlipemia is for the most part a hyperlipoidemia. There seems to be no distinct parallelism between cholesteremia and hyperglycemia in pregnancy. While we must believe that the endocrine glands are an important factor in this matter, the etiology of the condition has not yet become established.

OPHTHALMOLOGY

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Intra-orbital Foreign Bodies and Orbitotomy.—MERCIER (*Paris Thesis*, 1920) has made a study of intra-orbital foreign bodies, the material for which has been increased greatly by the war. An intra-orbital foreign body, if it is voluminous is easily recognized, for it betrays its presence by immediate symptoms of reaction to which is soon added an assemblage of very variable signs depending upon the damage occasioned by the projectile within the orbit (exophthalmos, paralysis of ocular muscles, pupillary disturbances, lesions of the optic nerve, or of the deeper membranes of the eye). If, however, the foreign body be but small, it frequently remains unperceived; under these circumstances radioscopy and radiography, according to the technic recommended by Velter, are indispensable, both for determining the presence and seat of the projectile. As soon as a positive diagnosis has been made, and it is of the greatest importance that this be done as soon as possible after the accident, the foreign body should be extracted, whatever its size, for tolerance is never definite, and sooner or later, serious accidents will supervene, which it is manifest should be avoided. Early intervention also facilitates cleansing of the wound and path of the projectile and permits of primary sutures. As it is indispensable to locate precisely the seat of the projectile by radiography before operation, radio-

scopic control is frequently very useful but unfortunately practicable only in a small number of hospitals. The operative procedure recommended by Mercier consists of orbitotomy with curvilinear incision of the orbital margin, while avoiding injury to the tissue of the conjunctival and palpebral apertures, and detachment of the periosteum from its external origin to the bottom of the orbit. The eyeball is then pushed aside and the region methodically explored with the palmar surface of the finger turned toward the globe. As soon as the projectile is felt, it is to be laid bare with a cannulated sound and extracted by forceps; the orbitotomy is done under local anesthesia; it is preferable to Krönlein's operation of bony resection. The site of the incision depends upon the seat of the foreign body; it may be external, infero-external, inferior, infero-internal, internal, supero-internal, superior, supero-external. The above operation suffices in the majority of cases; it permits not only extraction in case the foreign body has penetrated beyond the limits of the orbital cavity; but it also facilitates cleansing of the wound, removal of clots and contused tissue, as well as chips of bone. The lips of the wound should be sutured immediately after intervention, with occasional drainage for two or three days. The results are normal as a rule; shock is reduced to a minimum and the chances of infection are reduced to a minimum.

Lessons Gathered from the Observation of 12,000 Cases of Trachoma During the War.—STAICOVICI and LOBEL (*Archiv d'ophtal.*, November, 1920, p. 34), as the result of treatment of 12,000 cases of trachoma, come to the following conclusions: Notwithstanding the favorable results from surgical intervention, the treatment of granular conjunctivitis should aim at cure with the least possible destruction of the palpebral conjunctiva. The treatment should be individualized for every case. Frictions with medicaments, particularly sulphate of copper, practiced for a considerable time and especially in recent cases, appear to give the best results. It is indispensable to recognize the disease in the earliest phases of its evolution and to begin intervention at the earliest possible moment. As regards corneal complications, intervention must be begun early, either by peritomy in cases of pannus, or by subconjunctival injections when ulceration is present, without, however, intermitting the usual treatment. The lacrimal passages should also be kept under observation and the proper treatment instituted when necessary. In entropion and trichiasis, extirpation of the tarsus with preservation of the conjunctiva by careful dissection, is the procedure of choice.

Ocular Tension as an Autonomous Contractile Function of the Choroid.—NICATI (*Archiv d'ophtal.*, August, 1920, p. 449) concludes that the eye possesses an autonomous contractile function, the purpose of which is to maintain a constant equilibrium between the ocular tension and the arterial tension of the retina, which he terms the reflex *contre-cœur*. This function is seated in the choroid, a musculo-vascular contractile sac, with its own innervation, Müller's ganglion. Ocular tension depends upon the degree of repletion of the choroidal vessels; it is, besides, dependent upon global contraction of the choroid, as shown by transitory augmentation from excitation of the cervical

sympathetic. Accidental spasmodic contraction of the choroid, ocular colic, during the operation for cataract, causes, according to its intensity, presentation or loss of vitreous and hemorrhage, and when the latter is very intense, hernia of the choroid (expulsive hemorrhage). Ocular colic may also be reflex as when the aqueous humor is evacuated suddenly by puncture of the cornea. The painful attacks of spasmodic glaucoma are of a colicky nature; they are caused by excitation of Müller's ganglion from pressure. Acute, subacute and chronic primary glaucoma with hypertension is the consequence of paralysis of the choroid due to lesions of Müller's ganglion, the paralysis entraining choroidal stasis and edema which the flow of aqueous humor is unable to compensate. Secondary glaucoma is due to retention of the aqueous humor, the latter being no longer able to find an exit through the crypts of the atrophic or obstructed iris. Hypotension occurs in iritis, where it is the expression of participation of the choroid in the inflammatory process in certain cases of detachment of the retina and as the terminal stage of glaucoma.

Hot Springs in Ocular Affections.—Netto (*La Clin. Ophtal.*, October, 1920, p. 544) observes that in diseases of the eyes, the water of hot springs may be employed either by means of their vapors, local or general baths, or internal use, but their use is contraindicated in acute states. Lesions of the anterior segment are most suitable for thermal treatment. Lesions of the fundus require special care in the application of immersion baths; the temperature of the latter should be 35° C.; they are contraindicated in severe cases. Thermal baths aggravate affections of the optic nerve and deeper membranes. In ocular affections requiring sudorific treatment, thermal baths which provoke abundant perspiration are not to be recommended; in these cases general light radiation is to be preferred; the latter is also indicated in diseases of the fundus, stimulating the sudoriparous glands from which result slight perspiration and evaporation and thus inhibit accumulation of heat in the organism. The various forms of iritis, particularly the gonococcic are markedly improved by immersion baths. As lavage, the thermal springs frequently exert a favorable influence upon the various forms of conjunctivitis attended by abundant secretion. The radio-active waters have an undoubted influence upon inflammation of the conjunctiva, including trachoma.

Spectacles in Japan.—Onishi (*Klin. Monatsbl. f. Augenhk.*, July, 1920, p. 123) observes that there is no doubt but that spectacles were first brought to East Asia from Europe partly by sea through Singapore by Portuguese or East Indians, partly by land through Samarcand (1387 A.D. to 1432 A.D.) At this period, these articles were great rarities and very dear: in the age of Mins, a single pair of spectacles was valued at the price of a horse. Whether spectacles had made their appearance in these regions earlier than the above date, is difficult to determine; the writer considers it probable that the well known Franciscan monk Giovanni, the pioneer missionary to China, may have brought a pair to Pekin in 1293, spectacles having been discovered in Italy shortly before this date, and the missionary was of the age when optical aid was needed for near work. Spectacles were brought thence to Japan,

probably by F. X. Xavier; the latter made many valuable presents to the ruler of Yamaguchi, among which was probably a pair of spectacles. At this period, foreign merchants, Chinese or Portuguese, introduced spectacles into commerce in Hiroshima. The art of grinding spectacles is said to have been acquired by a certain Hamada in 1630 from the Dutch of Batavia or Formosa, while the Chinese brought the art about the same time to Nagasaki. The art of making glass was introduced about the year 800 into China from Rome or Constantinople by way of Turkestan, with which country China already at that early date carried on active commercial relations. The glassmaking art appears to have been known at a very early age in Japan, as the ancient term "Tamazukuribe," crystal maker, testifies; but it seems gradually to have been lost. Renewed fabrication of glass appears to have been again introduced as late as 1624–1643 into Nagasaki by Portuguese and Chinese.

Vossius's Lenticular Ring.—Behmann (*Klin. Monatsbl. f. Augenhk.*, February, March, 1920, p. 255) reporting three cases of Vossius's lenticular ring, concludes that the opacity is due to the impression of the pupillary margin upon the anterior surface of the lens; the mechanism of the impression is brought about by the action of the contusing force in such wise as to depress the cornea, so that cornea, iris and lens are brought into momentary contact: through transudation of a serofibrinous substance, the pigment adheres to the anterior surface of the lens giving rise to the ring or disk. In typical cases, the pigment deposit is left without any damage whatever to the capsule or cortical layers: that the opacity consists of pigment and not of blood or folding of the capsule, is proved by the demonstration of particles of pigment in the aqueous humor and upon the posterior surface of the cornea: these consist of the same material as the individual particles of the ring; while in the case of hemorrhage, upon disappearance of the blood, the opacity in the anterior chamber vanishes also, whereas the particles of pigment remain visible for a number of days. The opacity as a rule is occasioned by a force which acts upon the globe directly from in front; an identical opacity can also occur from an action upon the posterior section of the globe. Clearing of the opacity progresses from the center outward; the duration of the phenomenon averages about fourteen days; when more protracted, lens lesions must be assumed which are not a part, however, of a typical ring.

Xeroderma Pigmentosum.—Chevallereau and Offret (*Annal. d'oculist.*, April, 1920, p. 236) report a case of xeroderma pigmentosum in a boy of thirteen with good family history. The affection began two years before the report with a small papule at the canthus of the left eye; at the same time several other small papules appeared upon the face. As regards the disease of the left eye, the physician who first saw the lad, reports a tumor of the limbus involving the cornea and conjunctiva, strongly adherent, rose colored, readily bleeding and the size of a small hazel nut; the tumor was removed but recurred at once and increased enormously. Microscopic examination showed it to be an epithelioma of extreme gravity. The eye was enucleated by extensive incision of conjunctiva and healthy tissue: healing normal. The follow-

ing lesions are now present: face; classic manifestations of xeroderma pigmentosum; here and there small telangiectasies and atrophic white spots. The dominating lesions are yellow pigmented spots, some slightly raised, forming small tumors particularly upon the lower lids. Near the commissures of the lips and upon the alæ of the nose, are small, dry, warty horns, some ulcerated and infected; lymphatics not enlarged. The hollow of the right ear is filled with a tumor springing from the border of the antitragus; this tumor is mamelonated, sanious and covered in large part by a brownish membrane. The right eye presents a tumor upon the inner part of the sclero-corneal limbus, slightly involving the cornea—a papillary epithelioma. This growth, as well as those of the face and ear, were removed; they were all found to consist of Malpighian pavement epithelium in various stages of malignancy, from the precancerous of the eye to evident malignancy of those of the skin and especially the ear. All the sections showed inflammatory lesions intimately connected with neoplastic formations; numerous cocci, for the most part of the diplo variety, were noted. As regards therapeutics, the history of xeroderma pigmentosum teaches that this disease requires an extremely sombre prognosis; DuCastel writes that it is exceptional for the patient to live long beyond adolescence. In this case the roentgen rays were energetically applied with manifest amelioration; although in Darier's opinion radiotherapy should not be employed in Malpighian epitheliomas.

Errors of Diagnosis in Ophthalmology.—Vogt (*Cor.-Bl. f. Schw. Aerzte*, No. 4, vol. xlix) gives the following brief summary of diagnostic methods for recognizing important ocular conditions which may easily be overlooked. Foreign bodies: Before operating, make careful examination with the roentgen rays; also sideroscopic test. Very fine deposits in torpid cyclitis: Loup and mirror, Hartnack's loup; corneal microscope. In unilateral glaucoma, careful search for deposits to distinguish between secondary and primary affection. In doubtful cases, test tension only with tonometer of Schioetz: many pseudo-glaucomas can be recognized by this instrument; prolonged determinations of the tension should be made without a miotic; if the tension is found to be normal under these circumstances, cautiously instil a mydriatic and repeat the tonometric tests. Difficulty of seeing the lens in exudations into the pupil where Purkinje's images, the slit-lamp and sunlight are negative: in cases of this kind the method by fluorescence will frequently succeed. Differential diagnosis between optic neuritis and edema of the papilla, frequently so difficult, is facilitated by Gullstrand's ophthalmoscope; with this instrument prominences of the papilla, very circumscribed in the beginning come out clearly. It is interesting to note that in edema, the tissue of the papilla remains transparent for a long time. In inflammation adaptation to obscurity remains below normal for a considerable period, unlike in edema; in the former, also, narrowing of the visual field in sectors or other forms occurs sooner than in the latter. Green (red-free) light may also be utilized, for ordinarily in neuritis the retina is involved from the beginning, as may be recognized, particularly in youthful subjects, by the appearance of preretinal lines of reflection with double contours, an appearance often clearly apparent with the green but invisible to

ordinary light. In recent retrobulbar neuritis, lines of this nature, as well as the texture of the nerve fibers come out more clearly, while the macular reflex is modified or disappears entirely: in this condition, all other objective signs are absent. With green light, acute or subacute retrobulbar neuritis, frequent prodrome of sclerosia *en plaques*, will not go unperceived: the wrong diagnosis of hysteria will thus be avoided.

Autoplastic Restoration of Eyebrows.—MORAX (*Ann. d'ocul.*, May, 1920, p. 286) makes the interesting remark that the arch of the eyebrows, unlike the common belief that it has no other role than an esthetic one, possesses a very useful function in that it prevents the entrance of the perspiration from the brow into the eye. In the case of a palpebro-frontal burn, the absence of such a dam came out very unpleasantly and, in fact, it was this which caused the patient to consult Morax. Autoplastic restoration may be accomplished by two different autoplastic methods: autoplasty by displacement of pediculated, hair bearing, cutaneous flaps taken from the maxillary region of the opposite side (in case of unilateral alopecia of the eyebrow) or from the temporo-frontal region. This method is extremely satisfactory in complete alopecia of both eyebrows; by its means, hairbearing grafts can be obtained to any desired extent and of perfect symmetry. It is the method of choice whenever possible, that is where the temporo-frontal region has not been denuded of hair by cicatricial alopecia. Autoplasty with non-pediculated hair-bearing flaps may also give good results, but they are uncertain, and when successful, the number of hair follicles which survive transplantation are always greatly reduced as compared with the follicles originally present in the grafted tissue. This procedure, the techic of which is undoubtedly capable of improvement, may be applied where the neighboring hair-bearing regions (temporofrontal, bearded cheek) have been deprived of their hair follicles or are not adapted to autoplasty with a pediculated flap.

HYGIENE AND PUBLIC HEALTH

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A Study of the Relation of Family Income and Other Economic Factors to Pellagra Incidence in Seven Cotton-mill Villages of South Carolina in 1916.—GOLDBERGER, WHEELER and SYDENSTRICKER (*Public Health Reports*, November 12, 1920, No. 46, xxxv, 2673) present the results of a careful study of the subject, in which the various factors are fully considered. In this discussion it is pointed

out that the receipt of an adequate income does not necessarily guarantee an adequate diet, as individual tastes may have a predominating influence. It is suggested that economic depression may lead to an increased pellagra incidence in 1921. The following quotation of part of the discussion and of the summary and conclusions is presented: The very great importance of food availability in relation to pellagra prevalence seems heretofore not to have been very clearly recognized. Under some circumstances, as we have shown, this factor may operate notably to affect the character of the diet and thus the incidence of the disease. Our data dealt with differences in availability between localities of relatively small area, but it is readily conceivable that analogous differences may exist between areas of great extent such as there is reason to believe actually is the case between the northern and southern parts of the United States. This difference is probably an important factor (together with the well-known difference in dietary habit, Sydenstricker, 1915) in the notable inequality in the incidence of the disease in these two sections of the country. The results of the present study clearly suggest fundamental lines along which efforts looking to the eradication of the disease should be directed, namely, (1) economic, by improvement of economic status (income), and (2) food availability, by improvement in availability of food supplies. Measures for improving the economic status of those people most subject to the disease, are in the main, outside of the sanitarian's sphere and but little subject to his influence. While much the same may be said to apply to the conditions of food availability, this field is more easily accessible, both directly and indirectly, to his activities and influence. Thus, for instance, by avoiding ill-considered regulations governing milk production he can, negatively at least, favor an adequate supply of this invaluable food. Furthermore, he can and should aid in improving the conditions of food availability by lending his powerful influence in support of and, by coöperating with, the agencies at work in this field, in their efforts to stimulate milk production (particularly through cow ownership) and to induce the farmer to adopt a suitable system of crop diversification. And in this connection it may perhaps be remarked that certain preliminary observations have created in our minds a rather strong suspicion that the single-crop system as practiced in at least some parts of our southern states, by reason of apparently unfavorable conditions of food supply and of other conditions of an economic character bound up therein, will be found indirectly responsible for much of the pellagra morbidity and mortality with which local agricultural labor is annually afflicted. Although considerable study will be required to determine definitely the factors responsible for the high incidence of the disease in the rural areas in question, it would, nevertheless, seem to be the part of wisdom to make an earnest effort to improve conditions in the ways suggested above. The authors draw the following summary and conclusions: (1) In the present paper are reported the results of the part of the pellagra study of cotton-mill villages, during 1916, dealing with the relation of conditions of an economic nature to the incidence of pellagra. It is the first reported study in which the degree of the long-recognized association between poverty and pellagra incidence is measured in a definite,

ordinary light. In recent retrobulbar neuritis, lines of this nature, as well as the texture of the nerve fibers come out more clearly, while the macular reflex is modified or disappears entirely: in this condition, all other objective signs are absent. With green light, acute or subacute retrobulbar neuritis, frequent prodrome of sclerosia *en plaques*, will not go unperceived: the wrong diagnosis of hysteria will thus be avoided.

Autoplastic Restoration of Eyebrows.—MORAX (*Ann. d'ocul.*, May, 1920, p. 286) makes the interesting remark that the arch of the eyebrows, unlike the common belief that it has no other role than an esthetic one, possesses a very useful function in that it prevents the entrance of the perspiration from the brow into the eye. In the case of a palpebro-frontal burn, the absence of such a dam came out very unpleasantly and, in fact, it was this which caused the patient to consult Morax. Autoplastic restoration may be accomplished by two different autoplastic methods: autoplasty by displacement of pediculated, hair bearing, cutaneous flaps taken from the maxillary region of the opposite side (in case of unilateral alopecia of the eyebrow) or from the temporo-frontal region. This method is extremely satisfactory in complete alopecia of both eyebrows; by its means, hairbearing grafts can be obtained to any desired extent and of perfect symmetry. It is the method of choice whenever possible, that is where the temporo-frontal region has not been denuded of hair by cicatricial alopecia. Autoplasty with non-pediculated hair-bearing flaps may also give good results, but they are uncertain, and when successful, the number of hair follicles which survive transplantation are always greatly reduced as compared with the follicles originally present in the grafted tissue. This procedure, the techic of which is undoubtedly capable of improvement, may be applied where the neighboring hair-bearing regions (temporofrontal, bearded cheek) have been deprived of their hair follicles or are not adapted to autoplasty with a pediculated flap.

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AND

GEORGE W. McCOY, M.D.,

DIRECTOR OF HYGIENIC LABORATORY, UNITED STATES PUBLIC HEALTH SERVICE, WASHINGTON, D. C.

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purely objective manner. (2) The study was made among the white mill operatives' households in seven typical cotton-mill villages of South Carolina. Pellagra incidence was determined by a systematic, biweekly, house-to-house canvass and search for cases, only active cases being considered. Information relating to household food supply, family income, etc., was secured by enumerators for a sample section of the period April 16 to June 15, assumed to be representative of the season during which the factors favoring the production of pellagra were assumed to be most effective. (3) Family income was made the basis of classification according to economic status, the Atwater scale for food requirements being used for computing the size of families in comparing their incomes. (4) In general, pellagra incidence was found to vary inversely according to family income. As the income fell, the incidence of the disease rose and showed an increasing tendency to affect members of the same family; as the income fell, incidence fell, being reduced almost to the point of practical disappearance in the highest of our income classes, although the income enjoyed by this class was comparatively quite low. (5) The inverse correlation between pellagra incidence and family income depended on the unfavorable effect of low income on the character of the diet; but family income was not the sole factor determining the character of the household diet. (6) Differences in incidence among households of the same income class are attributable to the operation of such factors as tend to determine the amount and proportion of family income available for the purchase of food, the intelligence and ability of the housewife in utilizing the available family income, and to the differences among households with respect to availability of food supplies from such sources as home-owned cows, poultry, gardens, etc. (7) Differences in incidence among villages whose constituent households are economically similar, are attributable to differences among them in availability of food supplies resulting from differences (*a*) in the character of the local markets, (*b*) in the produce from adjacent farm territory, and (*c*) in marketing conditions. (8) The most potent factors influencing pellagra incidence in the villages studied were (*a*) low family income, and (*b*) unfavorable conditions regarding the availability of food supplies, suggesting that under the conditions obtaining in some of these villages in the spring of 1916 many families were without sufficient income to enable them to procure an adequate diet, and that improvement in food availability (particularly of milk and fresh meat) is urgently needed in such localities.

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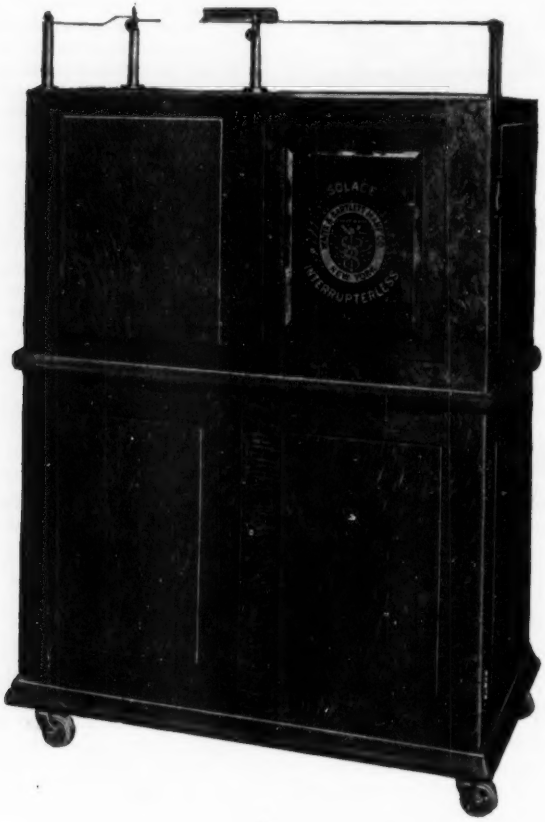

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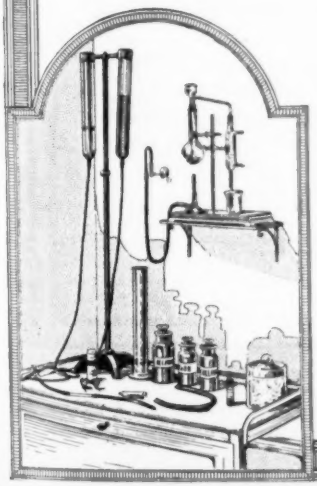

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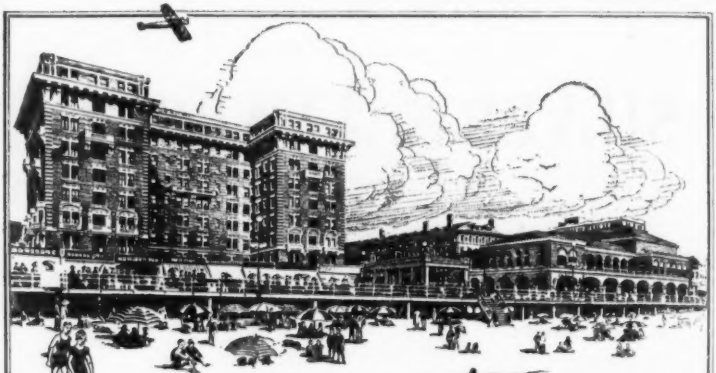

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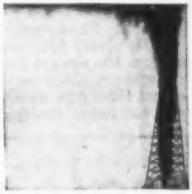

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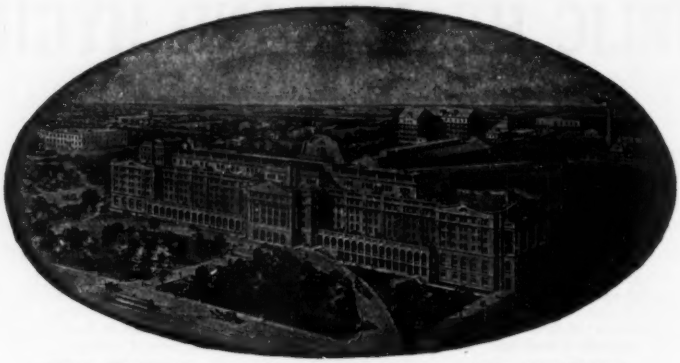

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